Antimicrobial Resistance Reporting: CP-CRE and *Candida auris*

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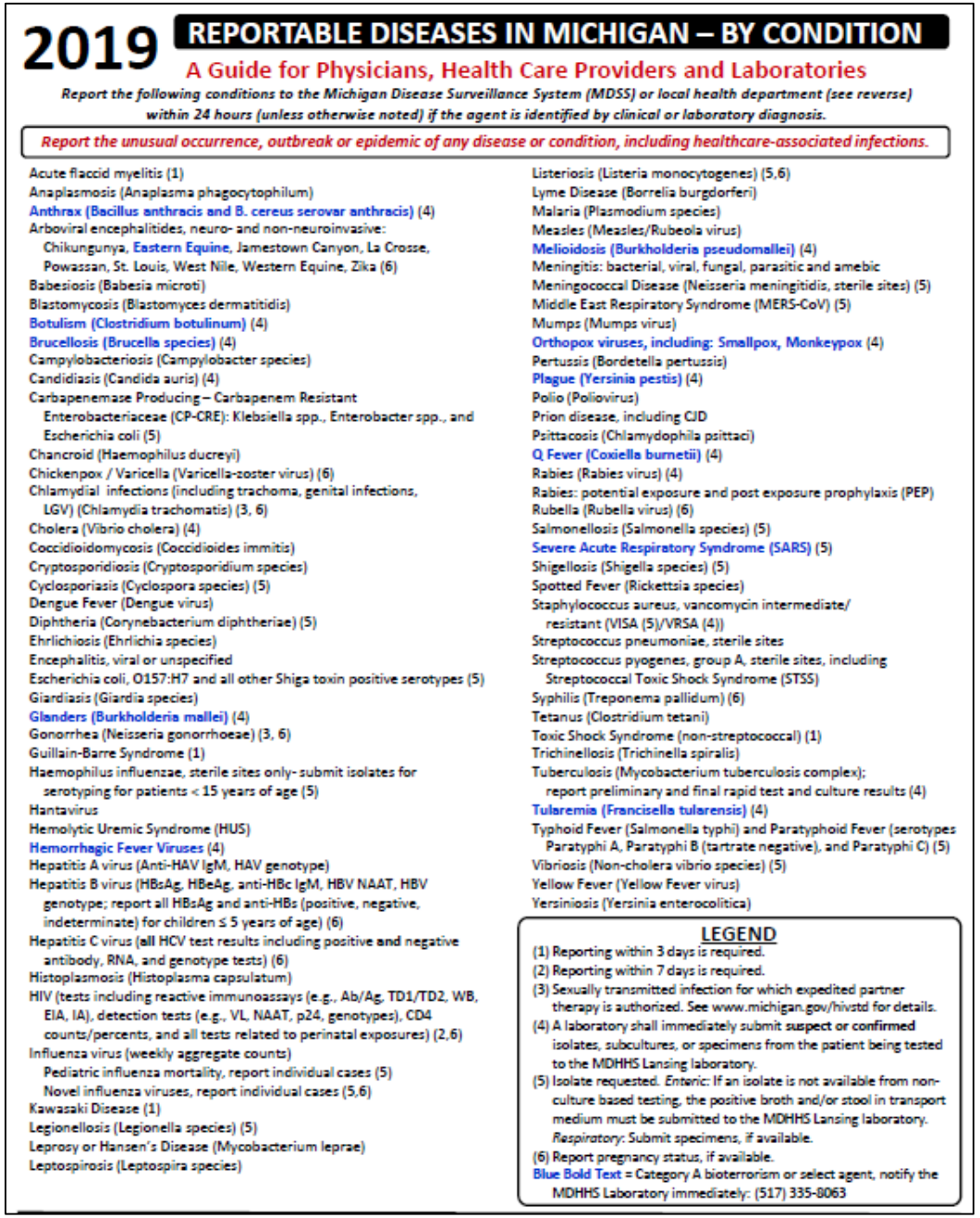
Antimicrobial Resistant Reportable Diseases

- Carbapenem-producing, carbapenem-resistant *Enterobacteriaceae* (CP-CRE)
- *Candida auris*
- Vancomycin Intermediate/Resistant *Staphylococcus aureus* (VISA/VRSA)
- Unusual occurrence, outbreak, or epidemic



2019 REPORTABLE DISEASES IN MICHIGAN – BY CONDITION

A Guide for Physicians, Health Care Providers and Laboratories

Report the following conditions to the Michigan Disease Surveillance System (MDSS) or local health department (see reverse) within 24 hours (unless otherwise noted) if the agent is identified by clinical or laboratory diagnosis.

Report the unusual occurrence, outbreak or epidemic of any disease or condition, including healthcare-associated infections.

Acute flaccid myelitis (1)
Anaplasmosis (Anaplasma phagocytophilum)
Anthrax (Bacillus anthracis and B. cereus serovar anthracis) (4)
Arboviral encephalitides, neuro- and non-neuroinvasive:
Chikungunya, **Eastern Equine**, Jamestown Canyon, La Crosse, Powassan, St. Louis, West Nile, Western Equine, Zika (6)
Babesiosis (Babesia microti)
Blastomycosis (Blastomyces dermatitidis)
Botulism (Clostridium botulinum) (4)
Brucellosis (Brucella species) (4)
Campylobacteriosis (Campylobacter species)
Candidiasis (Candida auris) (4)
Carbapenemase Producing – Carbapenem Resistant Enterobacteriaceae (CP-CRE): Klebsiella spp., Enterobacter spp., and Escherichia coli (5)
Chancroid (Haemophilus ducreyi)
Chickenpox / Varicella (Varicella-zoster virus) (6)
Chlamydial infections (including trachoma, genital infections, LGV) (Chlamydia trachomatis) (3, 6)
Cholera (Vibrio cholera) (4)
Coccidioidomycosis (Coccidioides immitis)
Cryptosporidiosis (Cryptosporidium species)
Cyclosporiasis (Cyclospora species) (5)
Dengue Fever (Dengue virus)
Diphtheria (Corynebacterium diphtheriae) (5)
Ehrlichiosis (Ehrlichia species)
Encephalitis, viral or unspecified
Escherichia coli, O157:H7 and all other Shiga toxin positive serotypes (5)
Giardiasis (Giardia species)
Glanders (Burkholderia mallei) (4)
Gonorrhea (Neisseria gonorrhoeae) (3, 6)
Guillain-Barre Syndrome (1)
Haemophilus influenzae, sterile sites only- submit isolates for serotyping for patients < 15 years of age (5)
Hantavirus
Hemolytic Uremic Syndrome (HUS)
Hemorrhagic Fever Viruses (4)
Hepatitis A virus (Anti-HAV IgM, HAV genotype)
Hepatitis B virus (HBsAg, HBeAg, anti-HBc IgM, HBV NAAT, HBV genotype; report all HBsAg and anti-HBs (positive, negative, indeterminate) for children ≤ 5 years of age) (6)
Hepatitis C virus (**all** HCV test results including positive **and** negative antibody, RNA, and genotype tests) (6)
Histoplasmosis (Histoplasma capsulatum)
HIV (tests including reactive immunoassays (e.g., Ab/Ag, TD1/TD2, WB, EIA, IA), detection tests (e.g., VL, NAAT, p24, genotypes), CD4 counts/percents, and all tests related to perinatal exposures) (2,6)
Influenza virus (weekly aggregate counts)
Pediatric influenza mortality, report individual cases (5)
Novel influenza viruses, report individual cases (5,6)
Kawasaki Disease (1)
Legionellosis (Legionella species) (5)
Leprosy or Hansen's Disease (Mycobacterium leprae)
Leptospirosis (Leptospira species)
Listeriosis (Listeria monocytogenes) (5,6)
Lyme Disease (Borrelia burgdorferi)
Malaria (Plasmodium species)
Measles (Measles/Rubeola virus)
Melioidosis (Burkholderia pseudomallei) (4)
Meningitis: bacterial, viral, fungal, parasitic and amebic
Meningococcal Disease (Neisseria meningitidis, sterile sites) (5)
Middle East Respiratory Syndrome (MERS-CoV) (5)
Mumps (Mumps virus)
Orthopox viruses, including: Smallpox, Monkeypox (4)
Pertussis (Bordetella pertussis)
Plague (Yersinia pestis) (4)
Polio (Poliovirus)
Prion disease, including CJD
Psittacosis (Chlamydophila psittaci)
Q Fever (Coxiella burnetii) (4)
Rabies (Rabies virus) (4)
Rabies: potential exposure and post exposure prophylaxis (PEP)
Rubella (Rubella virus) (6)
Salmonellosis (Salmonella species) (5)
Severe Acute Respiratory Syndrome (SARS) (5)
Shigellosis (Shigella species) (5)
Spotted Fever (Rickettsia species)
Staphylococcus aureus, vancomycin intermediate/resistant (VISA (5)/VRSA (4))
Streptococcus pneumoniae, sterile sites
Streptococcus pyogenes, group A, sterile sites, including Streptococcal Toxic Shock Syndrome (STSS)
Syphilis (Treponema pallidum) (6)
Tetanus (Clostridium tetani)
Toxic Shock Syndrome (non-streptococcal) (1)
Trichinellosis (Trichinella spiralis)
Tuberculosis (Mycobacterium tuberculosis complex); report preliminary and final rapid test and culture results (4)
Tularemia (Francisella tularensis) (4)
Typhoid Fever (Salmonella typhi) and Paratyphoid Fever (serotypes Paratyphi A, Paratyphi B (tartrate negative), and Paratyphi C) (5)
Vibriosis (Non-cholera vibrio species) (5)
Yellow Fever (Yellow Fever virus)
Yersiniosis (Yersinia enterocolitica)

LEGEND

(1) Reporting within 3 days is required.
(2) Reporting within 7 days is required.
(3) Sexually transmitted infection for which expedited partner therapy is authorized. See www.michigan.gov/hivstd for details.
(4) A laboratory shall immediately submit **suspect or confirmed** isolates, subcultures, or specimens from the patient being tested to the MDHHS Lansing laboratory.
(5) Isolate requested. *Enteric*: If an isolate is not available from non-culture based testing, the positive broth and/or stool in transport medium must be submitted to the MDHHS Lansing laboratory. *Respiratory*: Submit specimens, if available.
(6) Report pregnancy status, if available.
Blue Bold Text = Category A bioterrorism or select agent, notify the MDHHS Laboratory immediately: (517) 335-8063

Carbapenemase-producing Carbapenem-resistant *Enterobacteriaceae* (CP-CRE)

What are CP-CRE?

- ***Enterobacteriaceae*** – enteric bacteria, gram negative bacilli
- **Carbapenems** – class of broad-spectrum, β-lactam antibiotics
  - Used for the treatment of resistant infections
  - Only 4 carbapenems: doripenem, ertapenem, imipenem, and meropenem
- **Carbapenemases –** enzymes that break down carbapenem antibiotics
  - Often encoded on plasmids which can be shared between different bacteria

Risk Factors for CP-CRE

Older age

Antibiotic use

Multiple healthcare exposures

Acute care

Long-term care

Outside US

Recent surgery

Indwelling devices

Catheters

Ventilators

PEG tubes

Comorbid conditions

Cardiovascular disease

Diabetes

Chronic lung disease

Renal disease

CP-CRE Reporting

- Reportable disease in Michigan starting January 2018
- Surveillance definition endorsed by CSTE/CDC, nationally notifiable
- CP-CRE cases are reported using the Michigan Disease Surveillance System (MDSS)
  - Web-based communicable disease reporting system for the state of Michigan
  - Cases can be reported by:
    - Electronic laboratory report (ELR)
    - Manual case entry

CP-CRE Reporting Requirements

- Laboratories, infection prevention and Local Health Departments are required to report all cases of **CP-CRE** according to the following criterion for ***Klebsiella* spp.**, ***E. coli***, or ***Enterobacter* spp.**:
  - Healthcare record contains a diagnosis of Carbapenemase-producing Carbapenem-resistant Enterobacteriaceae (CP-CRE), KPC, NDM, OXA-48, IMP or VIM or other novel carbapenemase
  - Any isolate of ***Klebsiella* spp.**, ***E. coli***, or ***Enterobacter* spp.** demonstrating carbapenemase production by a **phenotypic test** (e.g., Carba NP, CIM, mCIM)
  - Any isolate of ***Klebsiella* spp.**, ***E. coli***, or ***Enterobacter* spp.** with a known carbapenemase resistance mechanism (e.g., KPC, NDM, OXA-48, IMP, VIM, or other carbapenemase gene) by a recognized **molecular test** (e.g., PCR, Expert Carba-R)

CP-CRE Reporting Requirements

- If laboratories are unable to detect **CP-CRE**, (*i.e.,* cannot test for carbapenemase production (phenotypic) or resistance mechanism (molecular test):
  - Report any isolate of ***Klebsiella spp., E. coli,*** or ***Enterobacter spp.*** with a **minimum inhibitory concentration (MIC)** of any of the following:
    - ≥4 mcg/ml for Meropenem
    - ≥4 mcg/ml for Imipenem
    - ≥4 mcg/ml for Doripenem
    - ≥2 mcg/ml for Ertapenem

Carbapenemase and Resistance Mechanism Testing

- Laboratories are ***strongly encouraged to submit CRE isolates*** to the MDHHS Bureau of Laboratories
  - Confirm organism identification
  - Perform modified carbapenem inactivation method (mCIM) testing
  - Perform PCR testing for KPC, NDM, OXA-48 like, IMP, VIM
    - If mCIM or PCR are positive, antimicrobial susceptibility testing (AST) will be performed

MDHHS Bureau of Laboratories Report

Antimicrobial Resistance Confirmation (ARC)

Gram Stain

Gram negative bacilli

Culture Results

Confirmed as Klebsiella pneumoniae

Identification Performed by MALDI-TOF.

Antimicrobial Susceptibility Results

	Klebsiella pneumoniae	
	MIC - Interpretation	
Amikacin	<=4	S
Aztreonam	>16	R
Cefepime	4	SDD
Cefotaxime	32	R
Ceftazidime	>16	R

Modified Carbapenem Inactivation Method

Positive

Phenotypic test

Modified Carbapenem Inactivation Method (mCIM) screen positive - this isolate demonstrates carbapenemase production. The clinical efficacy of the carbapenems has not been established for treating infections caused by Enterobacteriaceae and Pseudomonas aeruginosa that test carbapenem susceptible but demonstrate carbapenemase production in vitro. ISOLATES THAT ARE mCIM POSITIVE SHOULD BE CONSIDERED RESISTANT TO ALL CARBAPENEMS REGARDLESS OF MIC. MIC REPORTED FOR EPIDEMIOLOGIC PURPOSES ONLY.

PCR Result

KPC (bla-KPC) gene DNA Detected

Molecular test

NDM-1 (bla-NDM-1) gene DNA Not Detected

OXA-48 (bla-OXA-48 like) gene DNA Not Detected

VIM (bla-VIM) gene DNA Not Detected

KPC, NDM, OXA-48, and VIM are the most common carbapenemases in the United States, however there are other less common carbapenemases and other mechanisms of carbapenemase resistance not detected by this PCR assay.

IMP PCR Result

IMP (bla-IMP) gene DNA Not Detected

CP-CRE Case Classification

Confirmed CP-CRE

- ***Klebsiella spp., E. coli, Enterobacter spp.***
  - Positive **phenotypic test** or
  - Positive **carbapenem resistance mechanism**

Suspect CP-CRE

- ***Klebsiella spp., E. coli, Enterobacter spp.***
  - **Resistance to at least 1 carbapenem**
  - No phenotypic or molecular testing done

Not a Case

- BOL report is negative for phenotypic and molecular tests
- All carbapenems are susceptible (MICs don't match case definition)
- Not *Enterobactericeae*

CSTE Case definition
https://wwwn.cdc.gov/nndss/conditions/carbapenemase-producing-carbapenem-resistant-enterobacteriaceae/case-definition/2018/

Does this Isolate Meet Reporting Requirements?

- ✓ *Klebsiella pneumoniae*
- ✓ Carbapenemase production
- ✓ KPC carbapenemase gene detected
- ✓ Ertapenem MIC ≥ 4
- ✓ Meropenem MIC ≥ 16

= Confirmed CP-CRE Case

≥100,000 CFU/ml Klebsiella pneumoniae, see comment

Comment: Carbapenem resistant Enterobacteriaceae. Carbapenemase producer. KPC detected.

Antibiotic	MIC	Interpretation
Ampicillin	≥32	Resistant
Ampicillin/sulbactam	≥32	Resistant
Aztreonam	≥64	Resistant
Cefazolin	≥64	Resistant
Cefepime	2	Resistant
Ceftriaxone	8	Resistant
Ertapenem	≥4	Resistant
Gentamicin	≤2	Sensitive
Levofloxacin	≤1	Sensitive
Meropenem	≥16	Resistant
Piperacillin/tazobactam	64	Intermediate
Tobramycin	≤2	Sensitive
Trimethoprim/sulfamethoxazole	≤2	Sensitive

Does this Isolate Meet Reporting Requirements?

✓ *Enterobacter cloacae*

X No phenotypic or molecular carbapenemase testing reported

✓ Ertapenem MIC = 2

X Meropenem MIC = 1

= Suspect CP-CRE Case

≥100,000 CFU/ml Enterobacter cloacae, see comment

Comment: Carbapenem resistant Enterobacteriaceae.

Antibiotic	MIC	Interpretation
Ampicillin	≥32	Resistant
Ampicillin/sulbactam	≥32	Resistant
Aztreonam	≥64	Resistant
Cefazolin	≥64	Resistant
Cefepime	2	Resistant
Ceftriaxone	8	Resistant
Ertapenem	2	Resistant
Gentamicin	≤2	Susceptible
Levofloxacin	≤1	Susceptible
Meropenem	1	Susceptible
Piperacillin/tazobactam	64	Intermediate
Tobramycin	≤2	Susceptible
Trimethoprim/sulfamethoxazole	≤2	Susceptible

Does this Isolate Meet Reporting Requirements?

- ✓ *Escherichia coli*
- X No phenotypic or molecular carbapenemase testing reported
- ? Ertapenem and meropenem reported as 'Resistant' but no MIC value reported

= Can not tell if it meets the case definition or not

≥100,000 CFU/ml Escherichia coli, see comment

Comment: Carbapenem resistant Enterobacteriaceae.

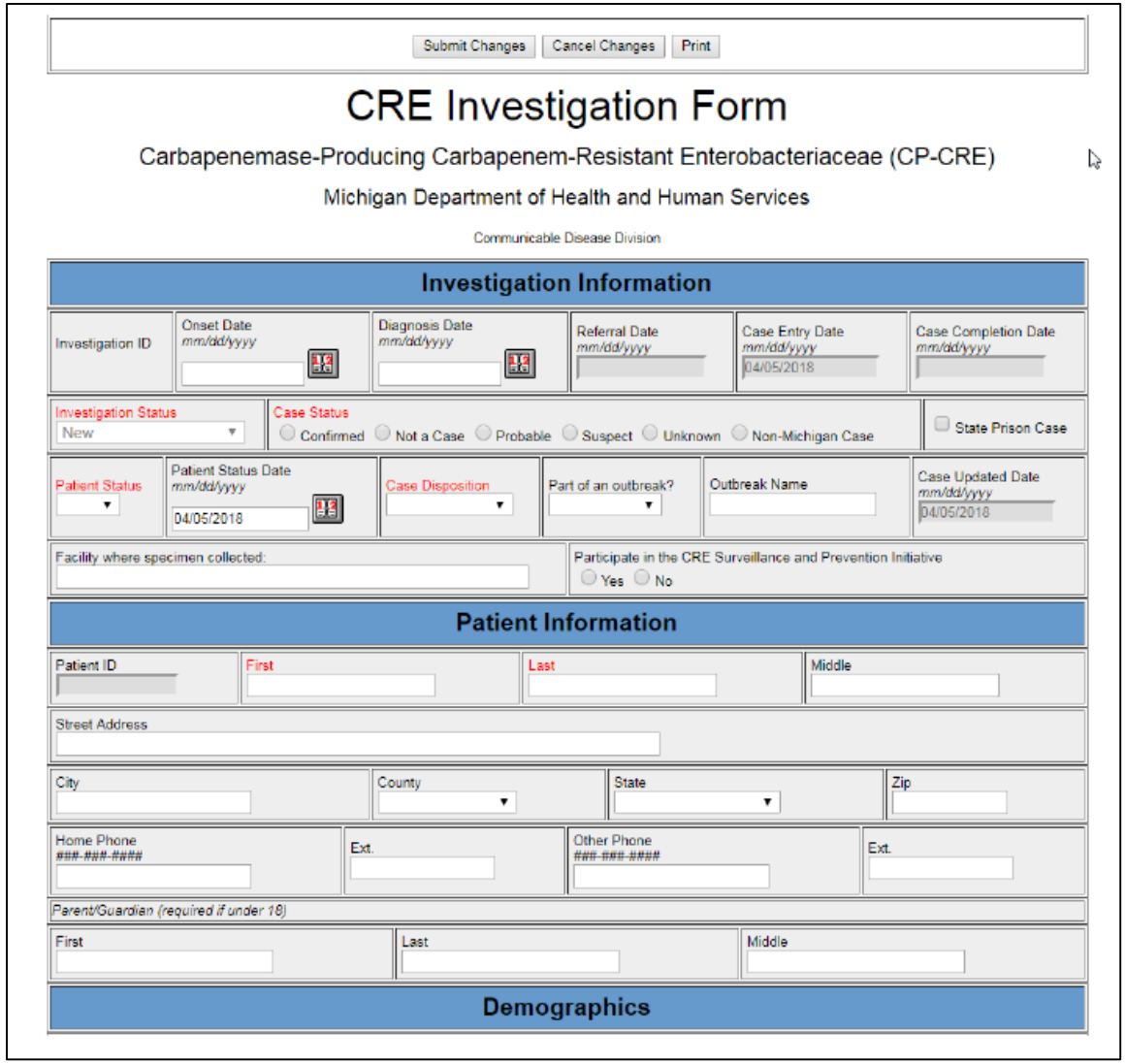
Antibiotic	MIC	Interpretation
Ampicillin	≥32	Resistant
Ampicillin/sulbactam	≥32	Resistant
Aztreonam		Resistant
Cefazolin		Resistant
Cefepime		Resistant
Ceftriaxone		Resistant
Ertapenem		Resistant
Gentamicin	≤2	Sensitive
Levofloxacin	≤1	Sensitive
Meropenem		Resistant
Piperacillin/tazobactam	64	Intermediate
Tobramycin	≤2	Sensitive
Trimethoprim/sulfamethoxazole	≤2	Sensitive

Tips for CP-CRE Reporting

- **Confirm the organism identification**
  - *Klebsiella* spp., *Escherichia coli, Enterobacter* spp.
- **Check for phenotypic carbapenemase testing**
  - ‘Carbapenemase detected’ or ‘Carbapenemae not detected’
  - Confirm the method used: mCIM, CarbaNP, MBL test
- **Check for molecular carbapenemase testing**
  - KPC, NDM, OXA-48, VIM, IMP
- **Confirm carbapenem MIC values**
  - Doripenem, imipenem, or meropenem ≥ 4 µg/ml; or ertapenem ≥ 2 µg/ml
  - If there are no MIC values reported (e.g., “Resistant”) or no carbapenems reported in MDSS, call the laboratory and ask to speak to a bench technologist

CP-CRE Case Investigation Form

- **CRE Investigation Form Sections**
  - Patient Information
  - Demographics
  - Laboratory Testing
  - Clinical Information
  - Antimicrobial Therapy



Submit Changes | Cancel Changes | Print

CRE Investigation Form

Carbapenemase-Producing Carbapenem-Resistant Enterobacteriaceae (CP-CRE)

Michigan Department of Health and Human Services

Communicable Disease Division

Investigation Information

Investigation ID | Onset Date mm/dd/yyyy | Diagnosis Date mm/dd/yyyy | Referral Date mm/dd/yyyy | Case Entry Date mm/dd/yyyy 04/05/2018 | Case Completion Date mm/dd/yyyy

Investigation Status: New | Case Status: Confirmed / Not a Case / Probable / Suspect / Unknown / Non-Michigan Case | State Prison Case

Patient Status | Patient Status Date mm/dd/yyyy 04/05/2018 | Case Disposition | Part of an outbreak? | Outbreak Name | Case Updated Date mm/dd/yyyy 04/05/2018

Facility where specimen collected: | Participate in the CRE Surveillance and Prevention Initiative: Yes / No

Patient Information

Patient ID | First | Last | Middle

Street Address

City | County | State | Zip

Home Phone ###-###-#### | Ext. | Other Phone ###-###-#### | Ext.

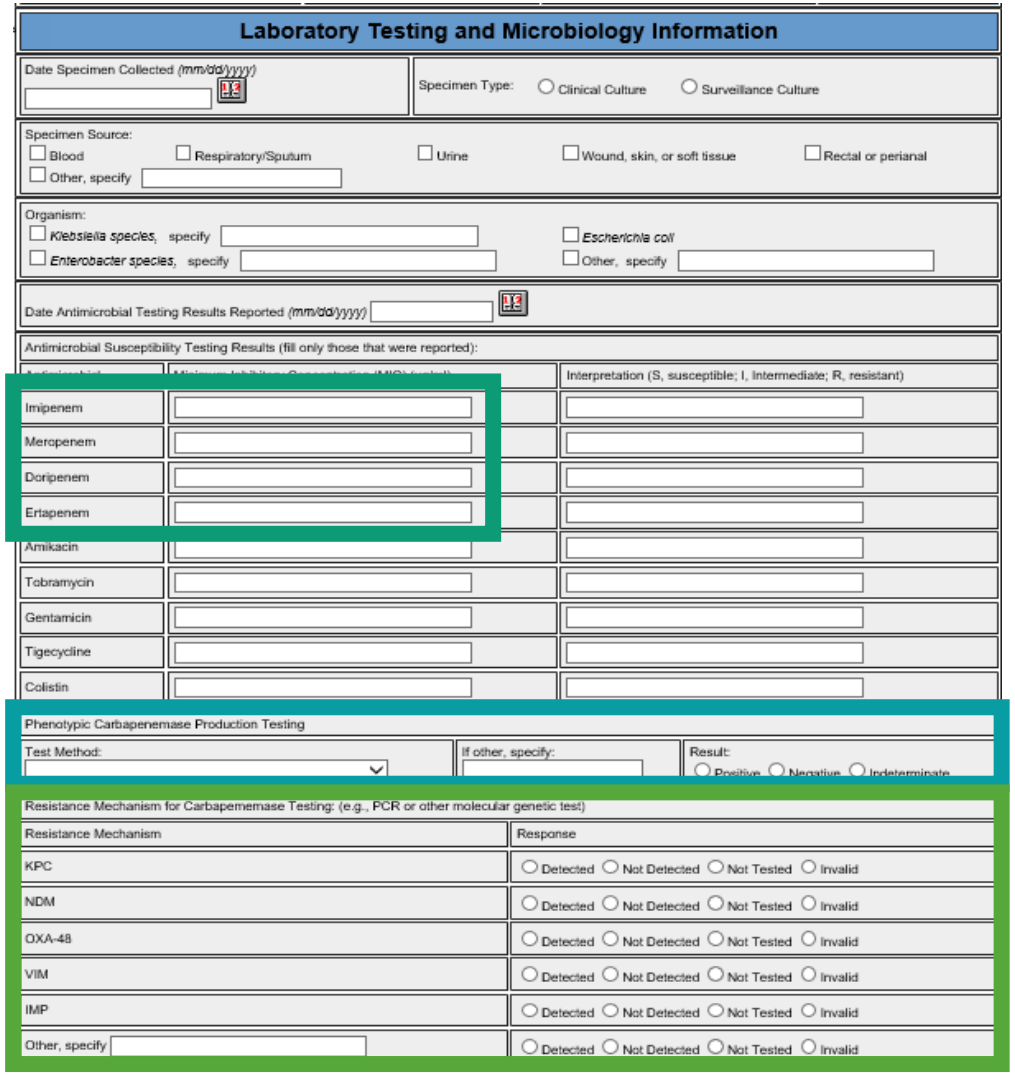
Parent/Guardian (required if under 18)

First | Last | Middle

Demographics

CP-CRE Laboratory Testing

- **Laboratory Testing information is required to determine case classification**
  - Date collected
  - Specimen source
  - Organism
  - MIC
    - need actual numerical value
  - Carbapenemase testing
    - e.g., mCIM, CarbaNP
  - Resistance mechanism testing
    - e.g. PCR, Carba-R



Laboratory Testing and Microbiology Information

Date Specimen Collected (mm/dd/yyyy)

Specimen Type: ○ Clinical Culture ○ Surveillance Culture

Specimen Source:
☐ Blood ☐ Respiratory/Sputum ☐ Urine ☐ Wound, skin, or soft tissue ☐ Rectal or perianal
☐ Other, specify

Organism:
☐ *Klebsiella species*, specify ☐ *Escherichia coli*
☐ *Enterobacter species*, specify ☐ Other, specify

Date Antimicrobial Testing Results Reported (mm/dd/yyyy)

Antimicrobial Susceptibility Testing Results (fill only those that were reported):

		Interpretation (S, susceptible; I, intermediate; R, resistant)
Imipenem		
Meropenem		
Doripenem		
Ertapenem		
Amikacin		
Tobramycin		
Gentamicin		
Tigecycline		
Colistin		

Phenotypic Carbapenemase Production Testing

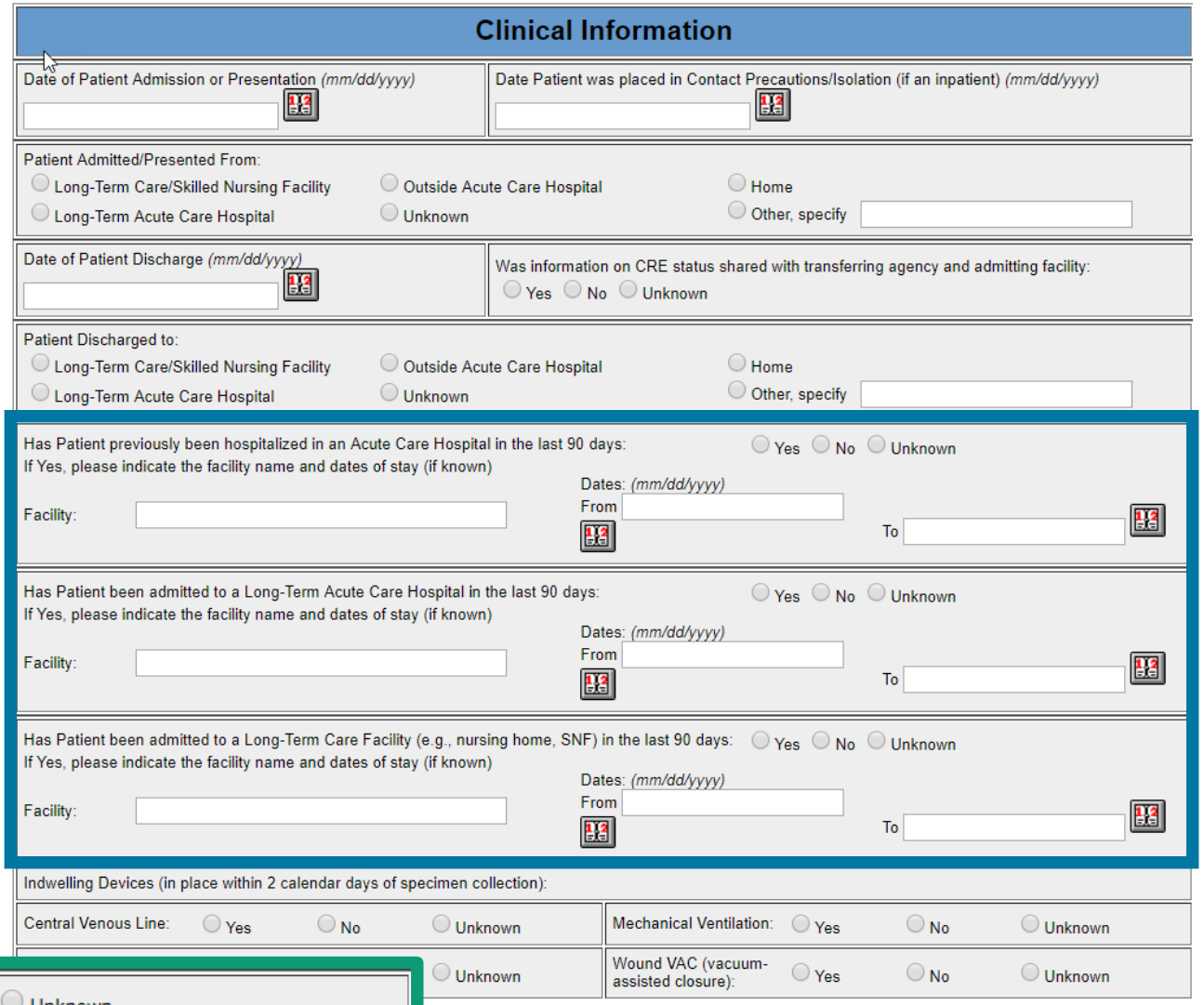
Test Method:	If other, specify:	Result: ○ Positive ○ Negative ○ Indeterminate

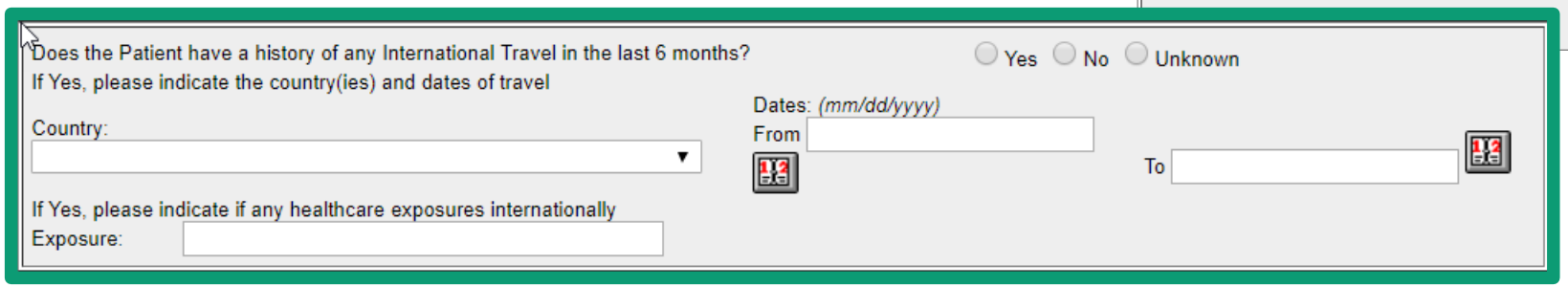
Resistance Mechanism for Carbapenemase Testing: (e.g., PCR or other molecular genetic test)

Resistance Mechanism	Response
KPC	○ Detected ○ Not Detected ○ Not Tested ○ Invalid
NDM	○ Detected ○ Not Detected ○ Not Tested ○ Invalid
OXA-48	○ Detected ○ Not Detected ○ Not Tested ○ Invalid
VIM	○ Detected ○ Not Detected ○ Not Tested ○ Invalid
IMP	○ Detected ○ Not Detected ○ Not Tested ○ Invalid
Other, specify	○ Detected ○ Not Detected ○ Not Tested ○ Invalid

CP-CRE Clinical Info

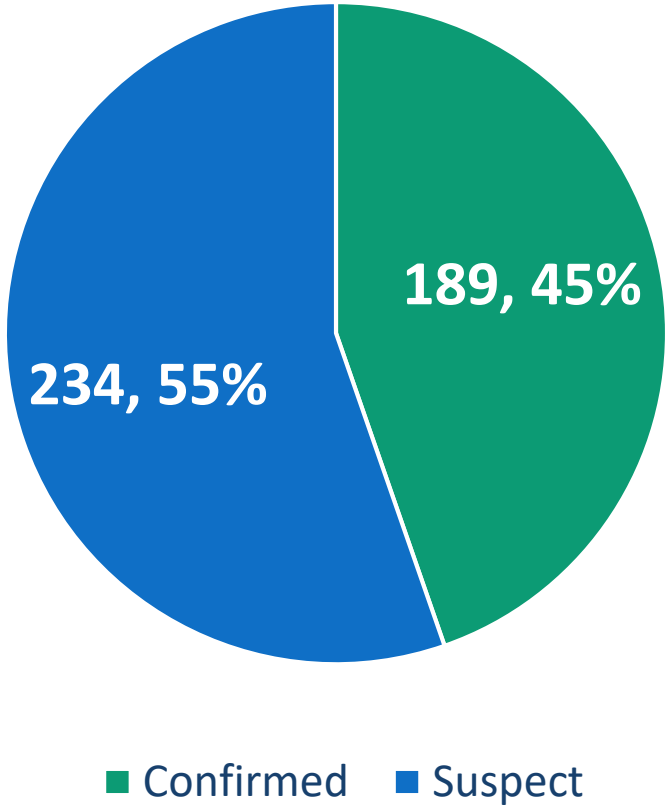
- Healthcare exposures
  - Acute care, long-term care
- Travel
  - Location
  - Healthcare abroad





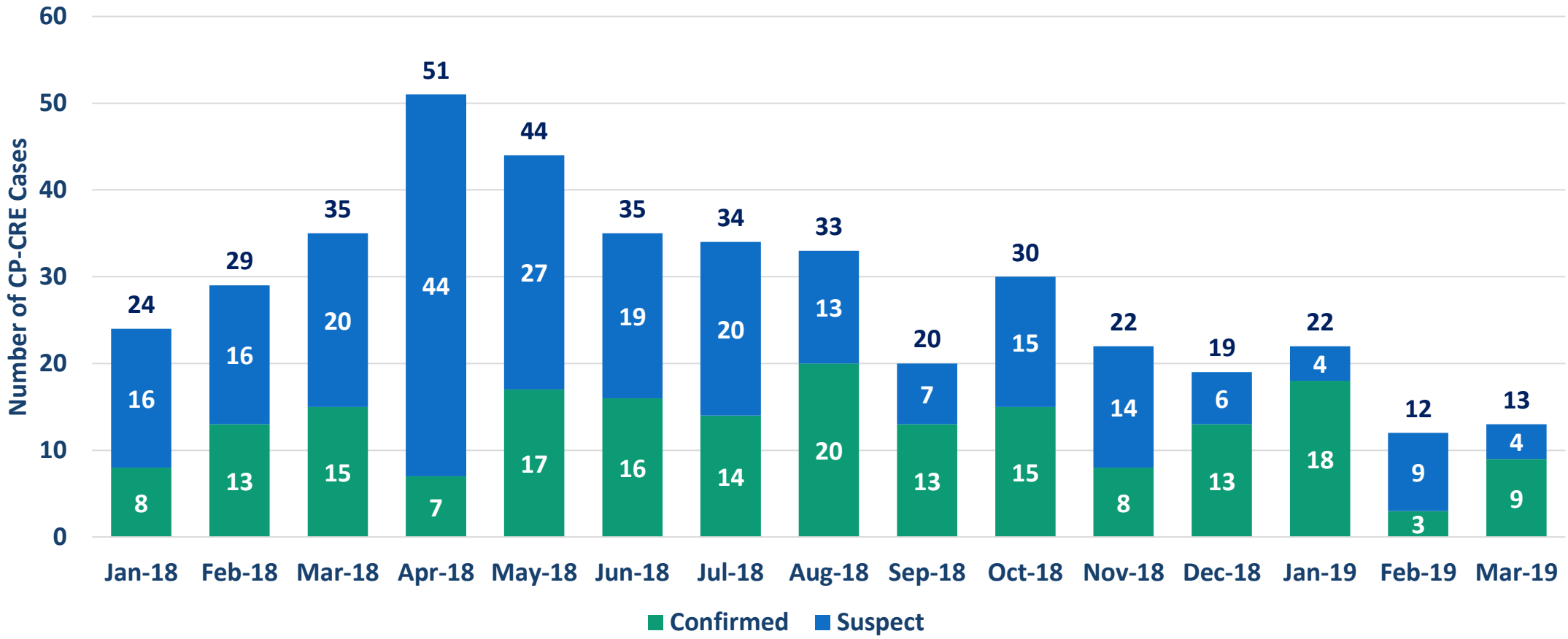
CP-CRE Cases Reported to MDSS

Jan 2018 – Mar 2019



CP-CRE Cases Reported to MDSS

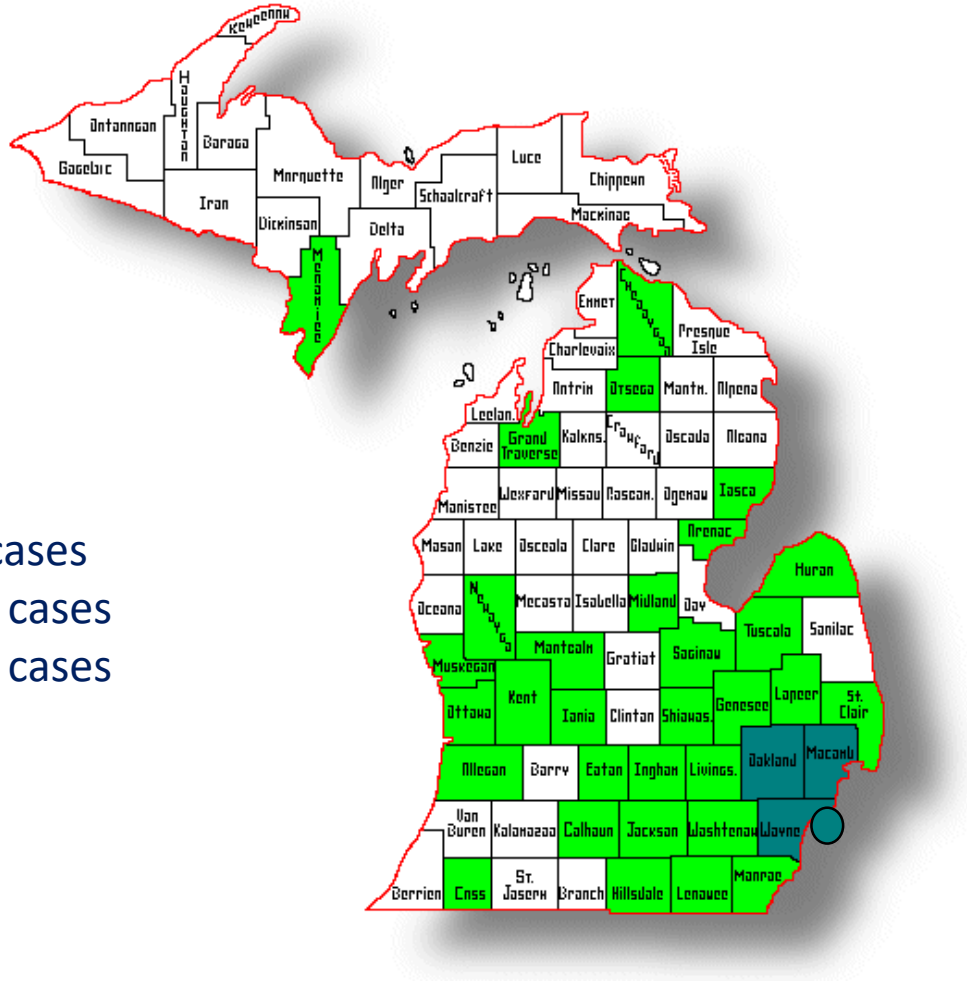
Jan 2018 – Mar 2019



CP-CRE Cases by County

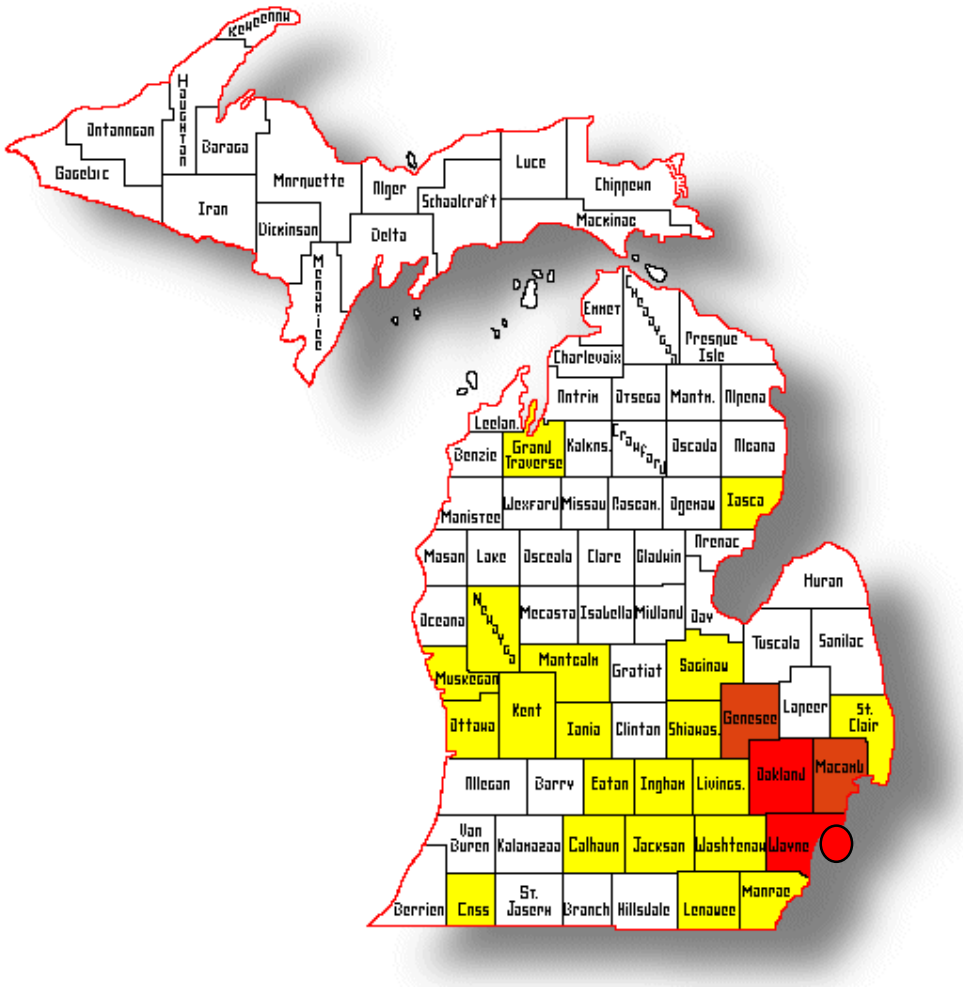
Jan 2018 – Mar 2019

Confirmed and Suspect CP-CRE



1-25 cases
26-50 cases
51-94 cases

Confirmed CP-CRE only



1-10 cases
11-20 cases
21-37 cases

*based on county of residence

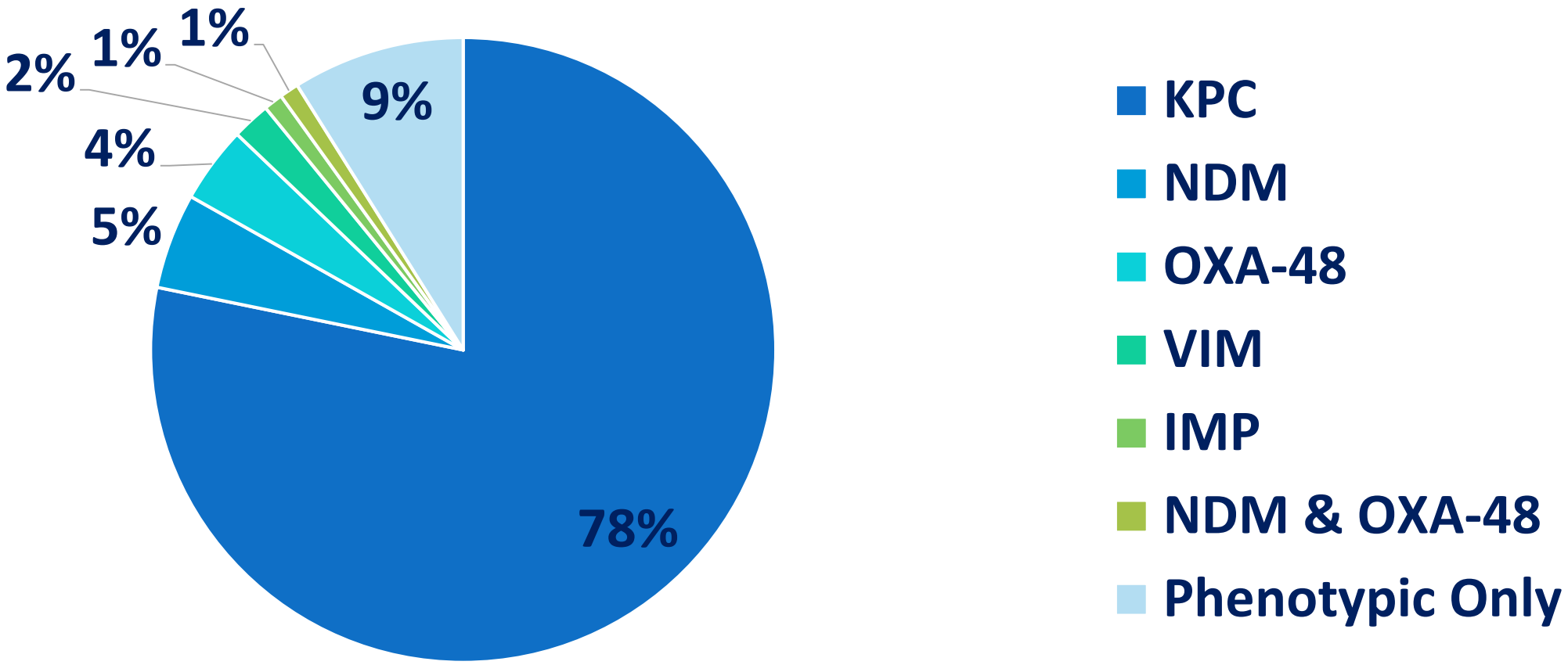
CP-CRE Cases by Organism

Jan 2018 – Mar 2019

Organism	CP-CRE Cases		
	Confirmed (n=189)	Suspect (n=234)	Total (n=423)
Klebsiella spp.	**126 (67%)**	**95 (41%)**	**221 (52%)**
Klebsiella pneumoniae	118	73	191
Klebsiella aerogenes	4	15	19
Klebsiella oxytoca	3	7	10
Klebsiella variicola	1	0	1
Enterobacter spp.	**36 (19%)**	**68 (29%)**	**104 (25%)**
Enterobacter cloacae	36	66	102
Enterobacter asburiae	0	1	1
Enterobacter hormaechei	0	1	1
Escherichia coli	**27 (14%)**	**71 (30%)**	**98 (23%)**

Confirmed CP-CRE Cases by Mechanism

Jan 2018 – Mar 2019



CDC Guidance for Novel MDRO Containment

- Response to a **single case** of resistance
- Goal to slow the spread of novel or unusual MDROs or resistance mechanisms
- Healthcare Contact Investigation
  - Notification/communication of status
  - Prompt implementation of precautions
  - Screening roommates
  - Screening broader healthcare contacts
  - Prospective and retrospective lab surveillance
  - Assessment of infection control practices

https://www.cdc.gov/hai/containment/guidelines.html

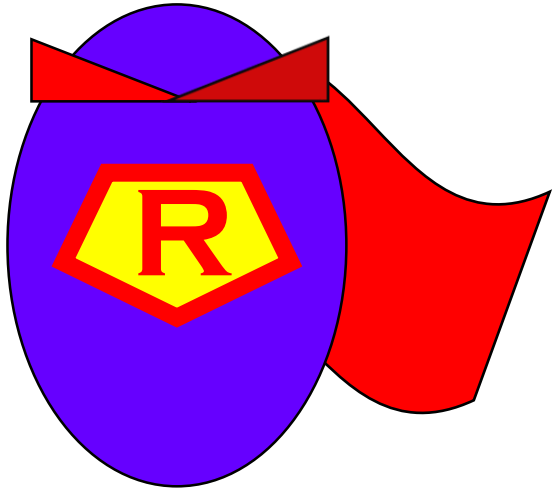
Considerations for CP-CRE Screening

- **Who to screen**
  - Epi-linked patient contacts of newly identified CP-CRE patients
  - Patients with an overnight stay in a healthcare facility outside the U.S. in the prior 6-12 months
  - Patients at high-risk for colonization
- **Colonization screen testing**
  - Available through MDHHS BOL
  - Rectal swab collection
  - Collection supplies are available for facilities (e.g., SNF)

Candida auris

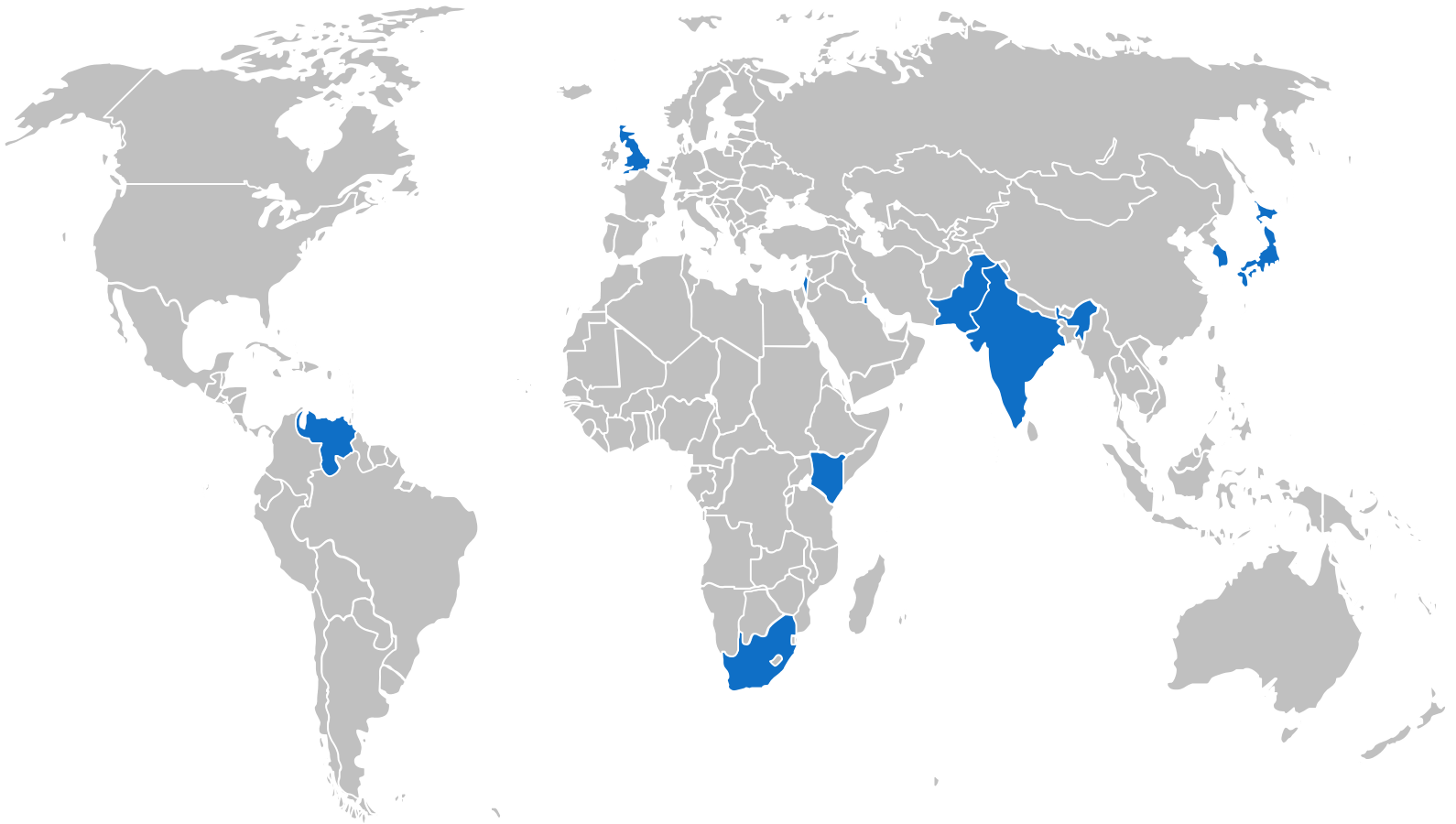
Candida auris is a Public Health Concern

- Recent worldwide emergence
- Highly drug-resistant yeast
- It can cause serious, invasive infections associated with high-mortality rates
- It is difficult to identify
- It can spread easily in healthcare settings



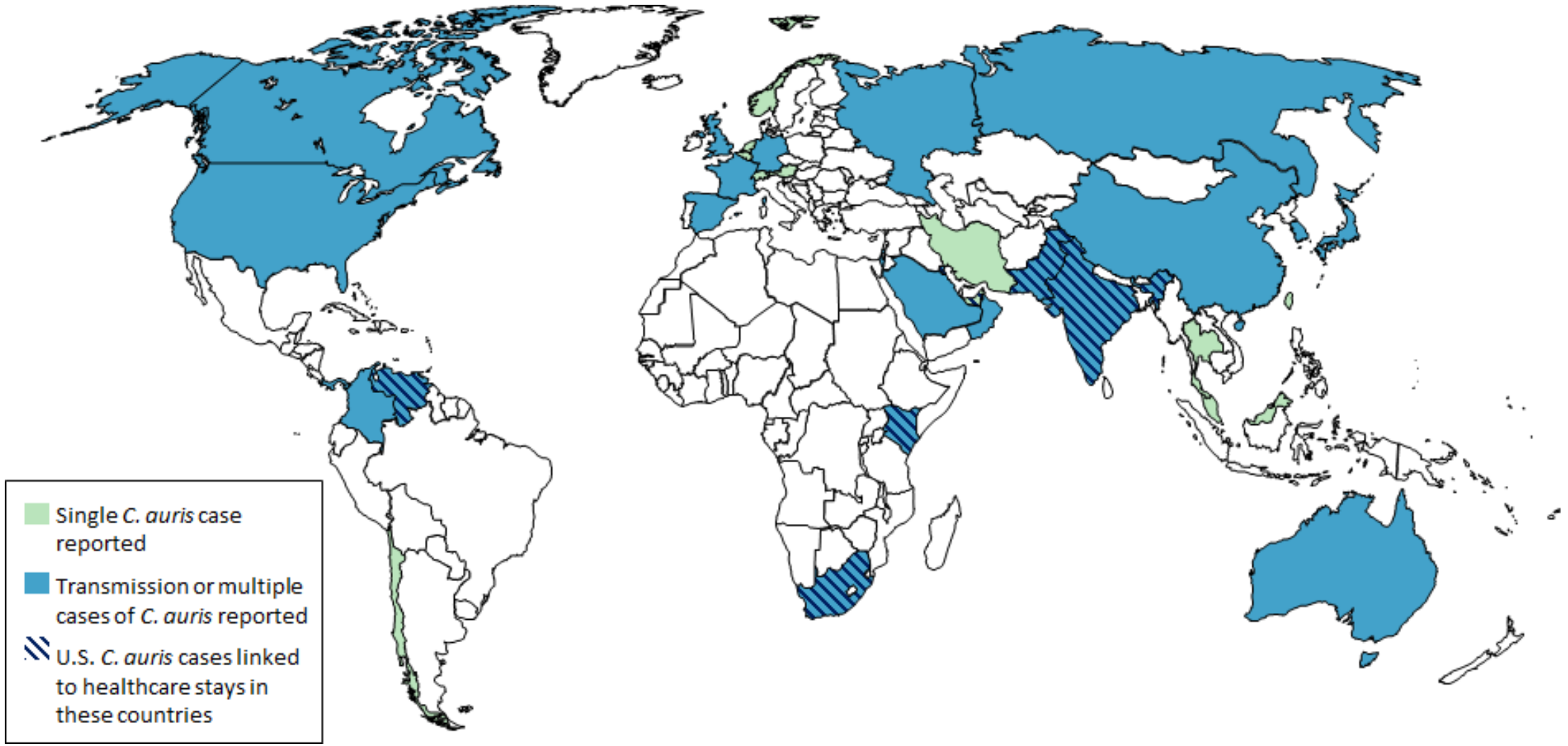
A Fungal Superbug!

Discovery of *Candida auris*



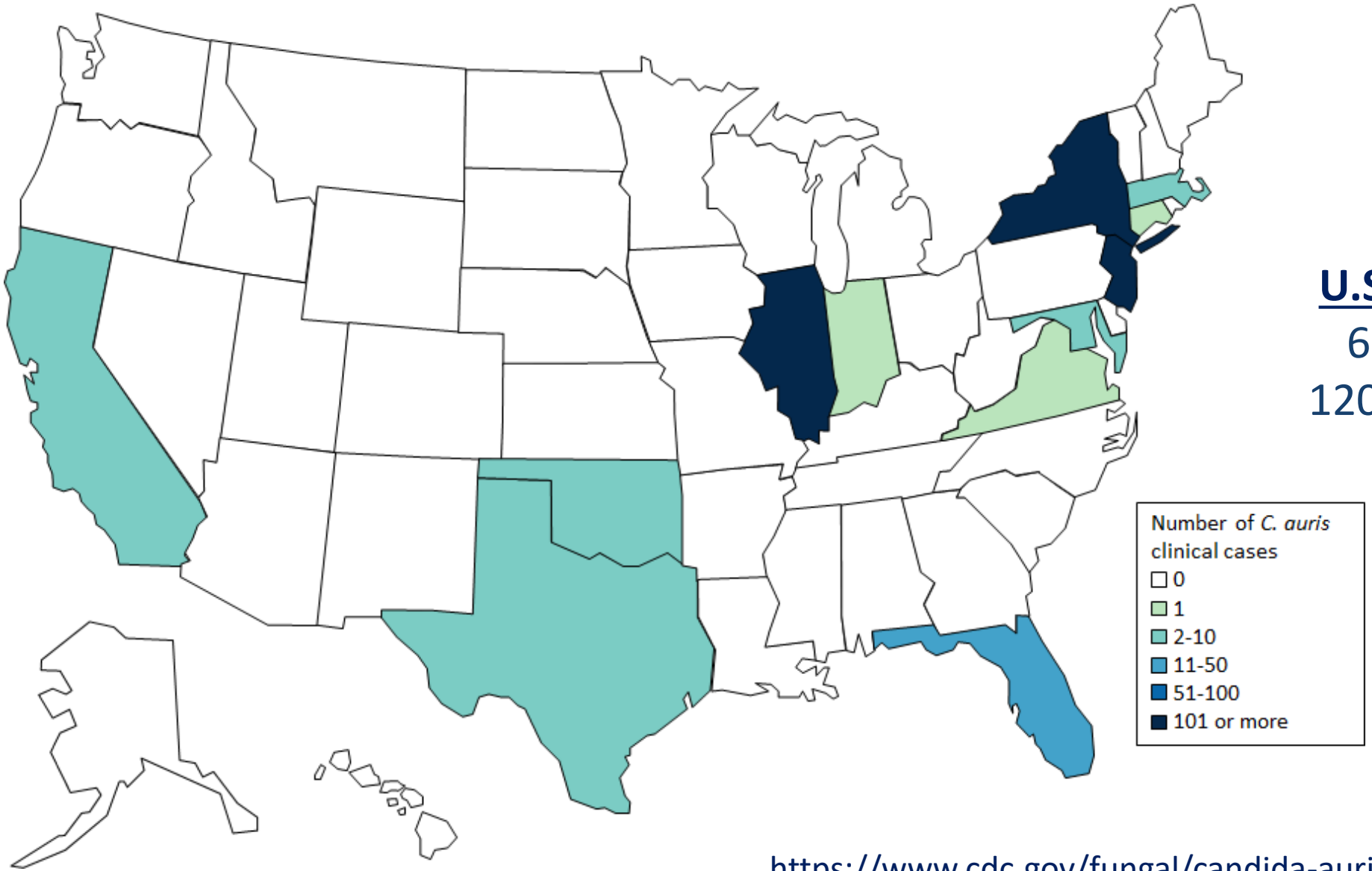
2009	2010	2011	2012	2013	2014	2015
Japan		South Korea		India	South Africa Kenya Kuwait	Pakistan Venezuela Israel UK

Reports of *Candida auris*, April 2019



https://www.cdc.gov/fungal/candida-auris/tracking-c-auris.html#world

Clinical Cases of *Candida auris*, April 2019



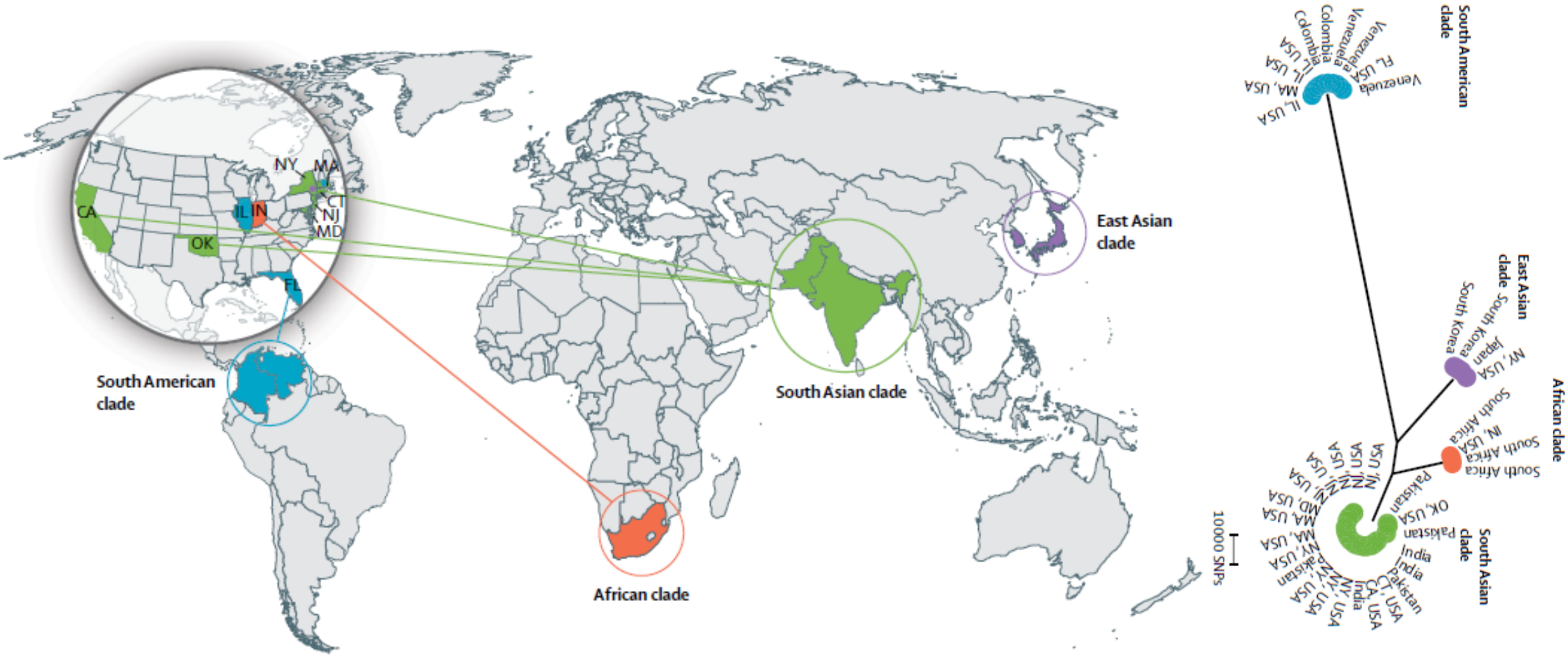
U.S. Cases Reported

654 Clinical Cases

1207 Screening Cases

https://www.cdc.gov/fungal/candida-auris/tracking-c-auris.html#world

U.S. Isolates Related to the 4 Known Clades



Chow et al. Lancet Infect Dis 2018;18:1377-84

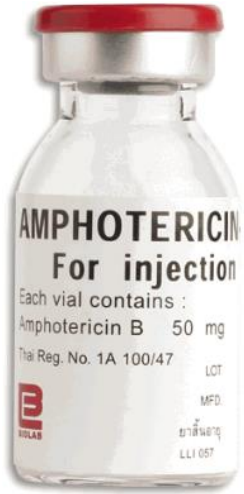
Antifungal Resistance is Common

>90%

Azoles

7%

Echinocandins



35%

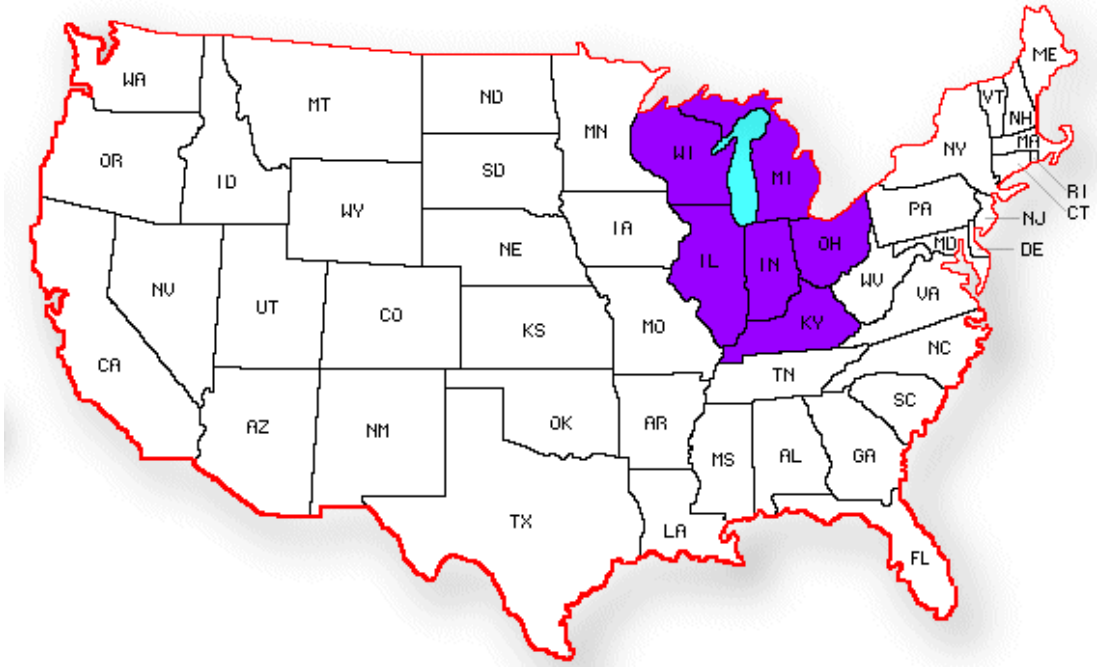
Polyenes

- >40% multi-drug resistant
- A few isolates resistant to all three classes

Lockhart et al. Clin Infect Dis 2017;64:134-140

Midwest Antifungal Resistance

- 2019 Q1 testing of 78 isolates:
  - 23.1% resistant to fluconazole
  - 0% resistant to amphotericin B
  - 2.6% resistant to echinocandins



Candida auris Causes Invasive Infections

- ~50% of clinical cases had bloodstream infections
- Candidemia associated with 30-60% mortality rates

Forsberg et al. Med Mycol. 2019;57(1):1-12

Risk Factors for *Candida auris*

Older age

Multiple healthcare exposures

Long-term care

Acute care

Outside US

Antifungals and antibiotics

Indwelling devices

Catheters

Ventilator

PEG tube

Comorbid conditions

Cancer

Diabetes

Renal Disease

Recent surgery

Candida auris Identification Can Be Difficult

- **Phenotypic characteristics are not sufficient for identification**
- **Many yeast identification methods may not correctly identify *C. auris***
  - Misidentification of species
  - No identification
- **Yeast isolates may not be identified, especially in non-invasive sites**
  - >40% of U.S. clinical cases were identified from non-bloodstream isolates (e.g., urine, wounds)

Candida auris on CHROMagar Candida, displaying multiple color morphs

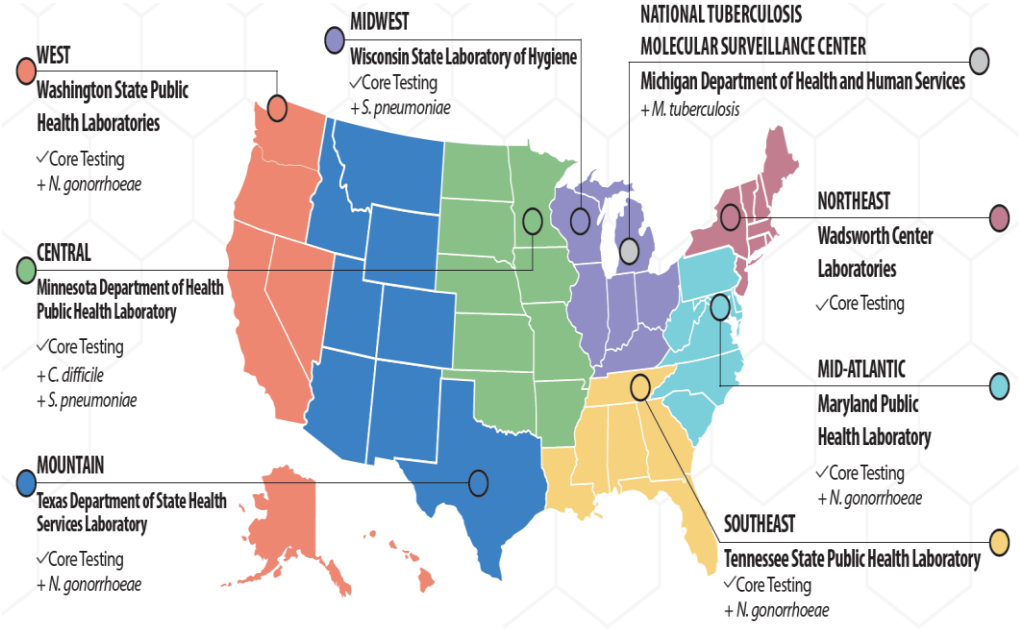
Identification Method	Database/Software, if applicable	*C. auris* is confirmed if initial identification is *C. auris*.	*C. auris* is possible if the following initial identifications are given. Further work-up is needed to determine if the isolate is *C. auris*.
Bruker Biotyper MALDI-TOF	RUO libraries (Versions 2014 [5627] and more recent)	*C. auris*	n/a
	CA System library (Version Claim 4)	*C. auris*	n/a
bioMérieux VITEK MS MALDI-TOF	RUO library (with Saramis Version 4.14 database and Saccharomycetaceae update)	*C. auris*	*C. haemulonii* No identification
	IVD library	n/a	*C. haemulonii* No identification
VITEK 2 YST	Software version 8.01	*C. auris*	*C. haemulonii* *C. duobushaemulonii* *Candida* spp. not identified
	Older versions	n/a	*C. haemulonii* *C. duobushaemulonii* *Candida* spp. not identified
API 20C		n/a	*Rhodotorula glutinis* (with characteristic red color present) *C. sake* *Candida* spp. not identified
BD Phoenix		n/a	*C. catenulata* *C. haemulonii* *Candida* spp. not identified
MicroScan		n/a	*C. lusitaniae** *C. guilliermondii** *C. parapsilosis** *C. famata* *Candida* spp. not identified
RapID Yeast Plus		n/a	*C. parapsilosis** *Candida* spp. not identified

* *C. guilliermondii, C. lusitaniae,* and *C. parapsilosis* generally make hyphae or pseudohyphae on cornmeal agar. If hyphae or pseudohyphae are not present on cornmeal agar, the isolate should raise suspicions of being *C. auris* as *C. auris* typically does not make hyphae or pseudohyphae. However, some *C. auris* isolates have formed hyphae or pseudohyphae. Therefore, it would be prudent to consider any *C. guilliermondii, C. lusitaniae,* and *C. parapsilosis* isolates identified on MicroScan and any *C. parapsilosis* isolates identified on RapID Yeast Plus as possible *C. auris* isolates and further work-up should be considered.

https://www.cdc.gov/fungal/diseases/candidiasis/pdf/Testing-algorithm-by-Method-temp.pdf

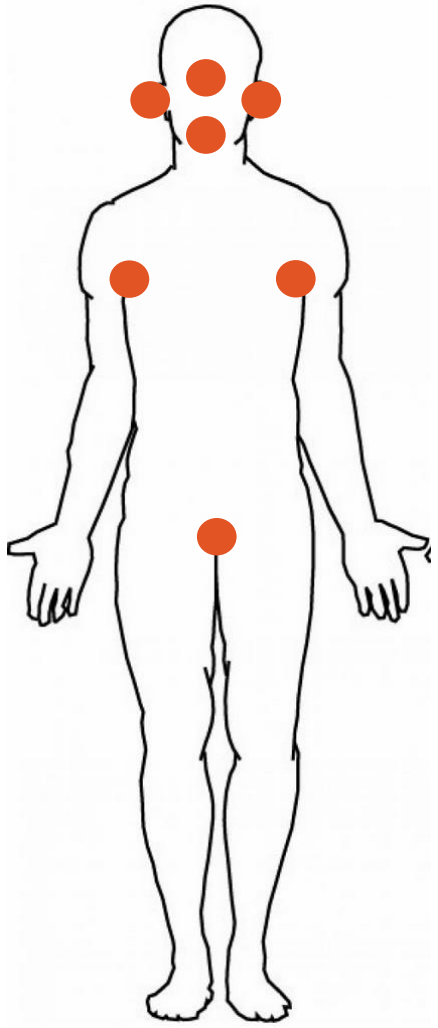
Candida Testing Available

- **Labs can send isolates to MDHHS BOL → ARLN**
- **Isolates to send:**
  - Any confirmed or suspected *Candida auris* isolates
  - Any *Candida* species that was unable to be identified after a validated method was attempted
  - *Candida* from normally sterile sites (except *C. albicans* or *C. glabrata*)
  - Multi-drug resistant *Candida* isolates
  - Unusual *Candida* species

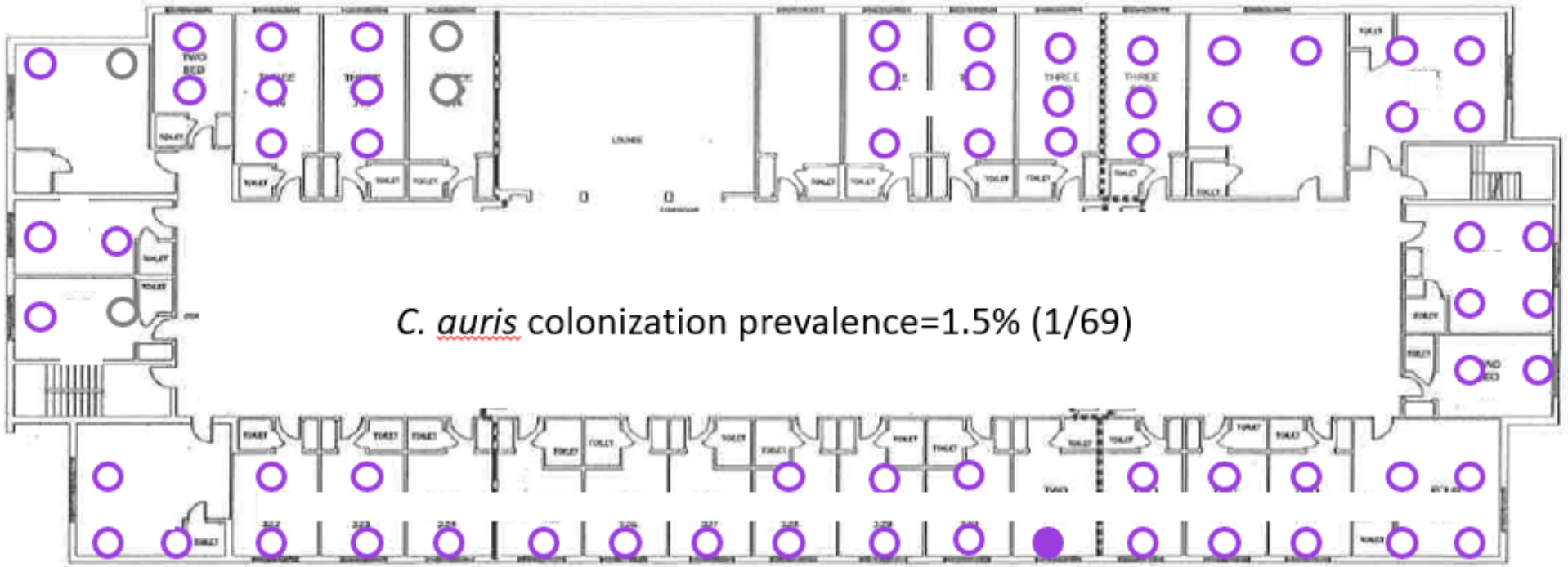


Candida auris Colonizes Skin & Other Body Sites

- **Colonization is a risk for:**
  - Invasive infections
  - Transmission to other patients
- **Duration of colonization can be prolonged**
- **Higher rates of colonization in high-acuity long-term care facilities**



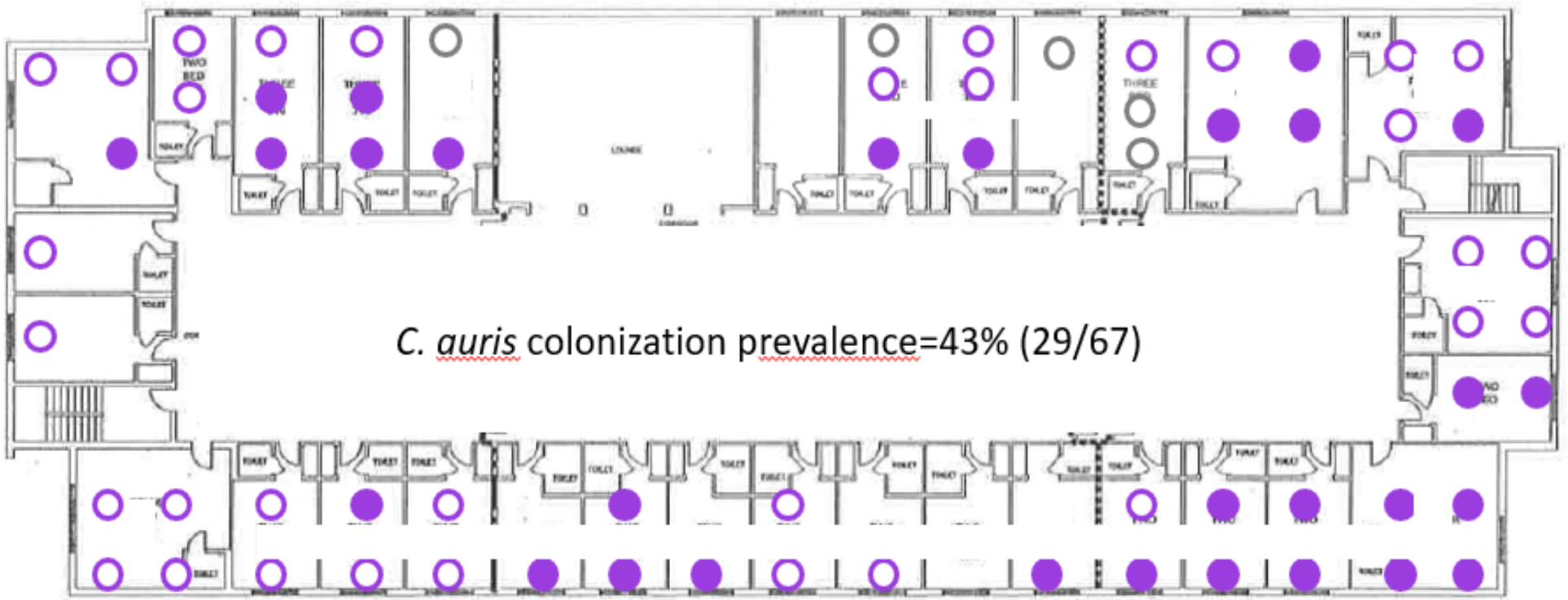
vSNF A Ventilator/Trach Floor
March 2017 *C. auris* PPS Results



- *C. auris* positive
- Screened negative for *C. auris*
- Not tested for C. auris (refused or not in room)

Slide courtesy of Chicago Department of Public Health.

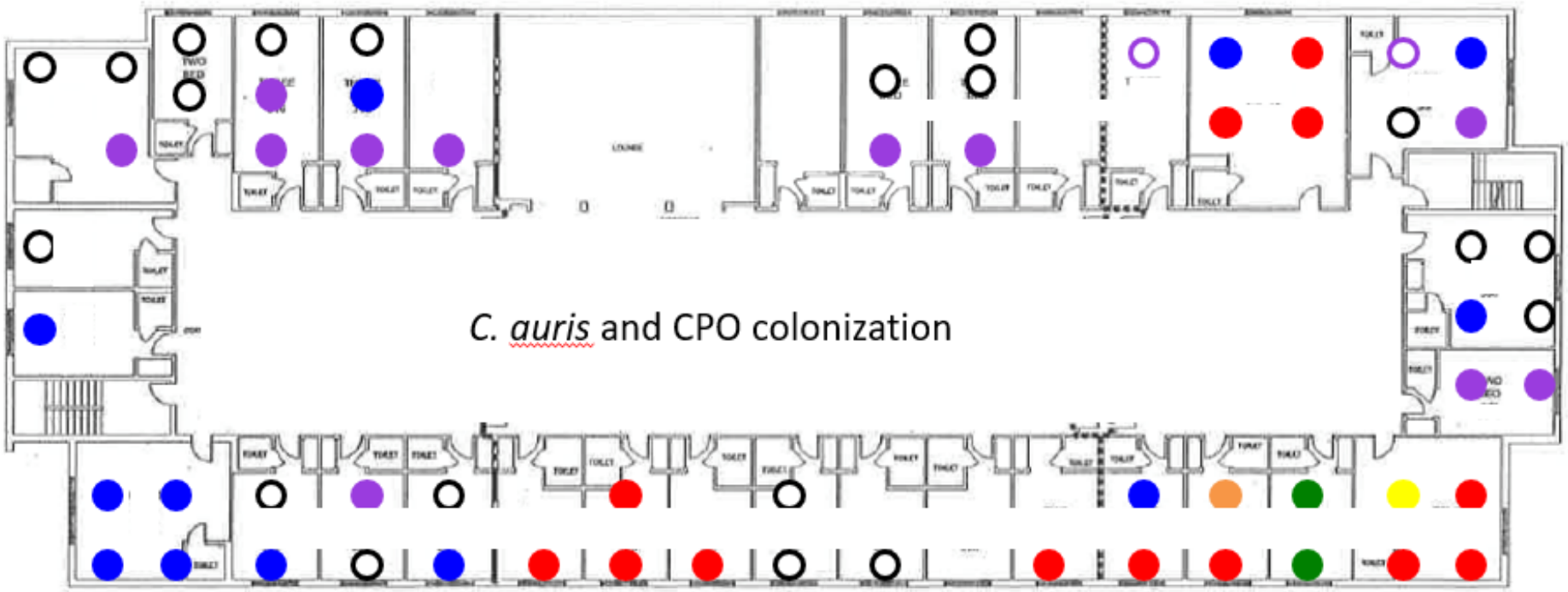
vSNF A Ventilator/Trach Floor
January 2018 *C. auris* PPS Results



- *C. auris* positive
- Screened negative for *C. auris*
- Not tested for C. auris (refused or not in room)

Slide courtesy of Chicago Department of Public Health.

vSNF A Ventilator/Trach Floor
January 2018 CPO and *C. auris* PPS Results

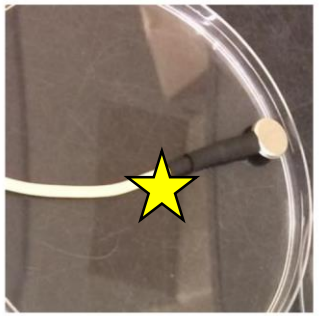


- *C. auris*
- *C. auris* and KPC
- KPC or CRE with unknown mechanism of resistance
- *C . auris*, KPC, and NDM
- *C. auris*, VIM-CRPA, and KPC
- *C. auris* and KPC-CRPA

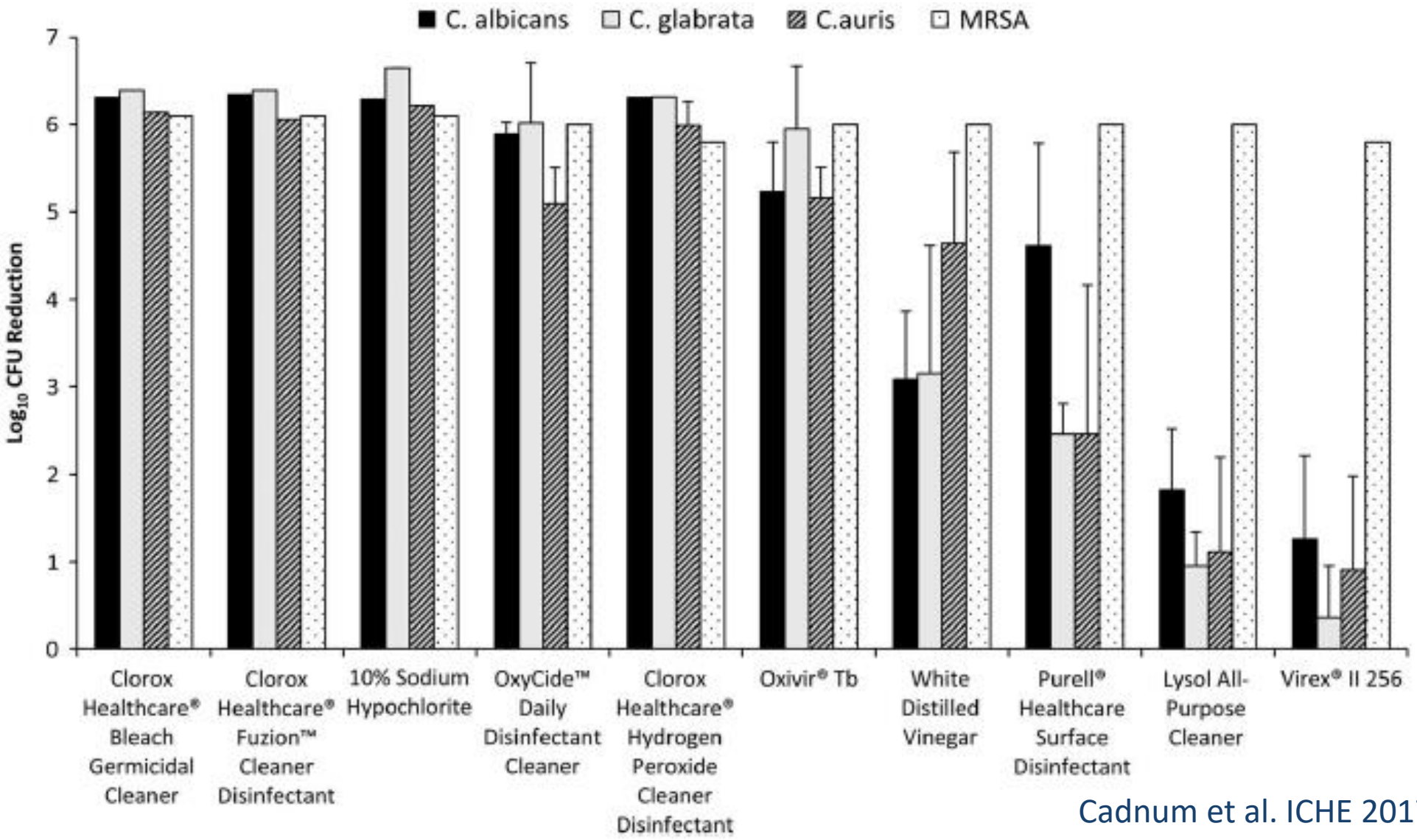
- Screened negative for *C. auris*, but not tested for CRE
- Screened negative for CRE and *C. auris*

Slide courtesy of Chicago Department of Public Health.

Candida auris Can Persist in the Environment



Routine Disinfectants Not as Effective



Cadnum et al. ICHE 2017; 38:1240-1243

Candida auris is Now a Reportable Condition

- June 2018 - CSTE position statement for standardized *C. auris* case definition and national notification of cases was passed

- January 1, 2019 - *C. auris* was made a reportable condition in Michigan

https://cdn.ymaws.com/www.cste.org/resource/resmgr/ps/2018ps/18-ID-05_Dec2018_Update.pdf

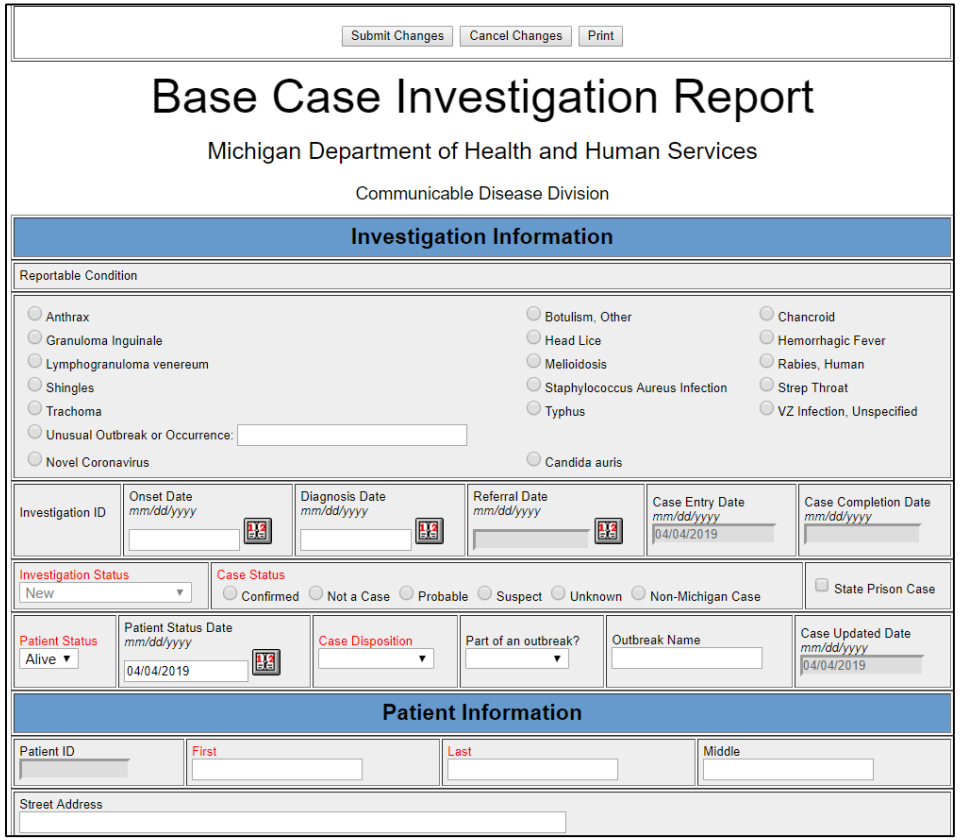
Candida auris Reporting Requirements

- **Please report any laboratory finding that meets either of the following criteria:**
  - Detection of *C. auris* in a specimen using either culture or a culture-independent diagnostic test (CIDT) (e.g., Polymerase Chain Reaction [PCR])
  - Detection of an organism that commonly represents a *C. auris* misidentification in a specimen by culture (i.e., *Candida haemulonii*)

- **Laboratories shall immediately submit confirmed or suspect *C. auris* isolates, subcultures, or specimens from the patient being tested to the MDHHS Lansing laboratory (Required)**

Candida auris Reporting in MDSS

- **At this time, base case form is available**
  - Expecting to have a *C. auris* specific form by late 2019/early 2020
- **Important information to collect:**
  - Demographics
  - Laboratory testing results
  - Where specimen was collected
  - Healthcare facility exposures
    - Long-term care residence
  - Tracheostomy/ventilator use
  - Travel history: International and Domestic
  - MDRO status



Submit Changes | Cancel Changes | Print

Base Case Investigation Report

Michigan Department of Health and Human Services

Communicable Disease Division

Investigation Information

Reportable Condition

Anthrax; Botulism, Other; Chancroid
Granuloma Inguinale; Head Lice; Hemorrhagic Fever
Lymphogranuloma venereum; Melioidosis; Rabies, Human
Shingles; Staphylococcus Aureus Infection; Strep Throat
Trachoma; Typhus; VZ Infection, Unspecified
Unusual Outbreak or Occurrence:
Novel Coronavirus; Candida auris

Investigation ID	Onset Date mm/dd/yyyy	Diagnosis Date mm/dd/yyyy	Referral Date mm/dd/yyyy	Case Entry Date mm/dd/yyyy	Case Completion Date mm/dd/yyyy
				04/04/2019	

Investigation Status: New
Case Status: Confirmed; Not a Case; Probable; Suspect; Unknown; Non-Michigan Case
State Prison Case

Patient Status	Patient Status Date mm/dd/yyyy	Case Disposition	Part of an outbreak?	Outbreak Name	Case Updated Date mm/dd/yyyy
Alive	04/04/2019				04/04/2019

Patient Information

Patient ID	First	Last	Middle

Street Address

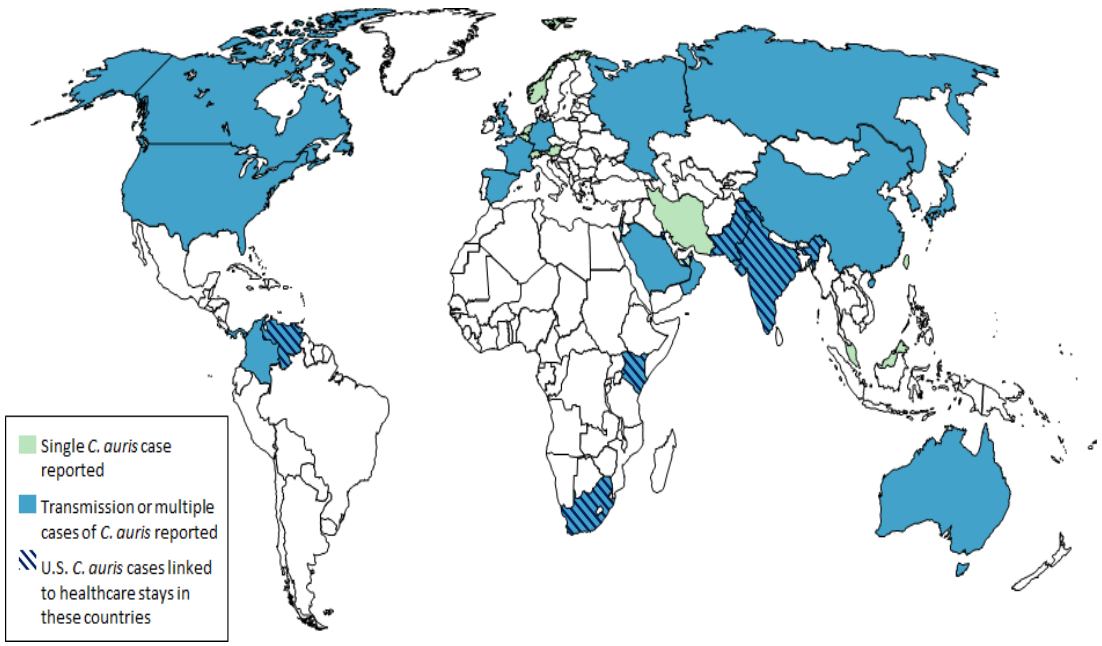
CDC Guidance for Novel MDRO Containment

- Response to a **single case** of resistance
- Goal to **slow the spread** of novel or unusual MDROs or resistance mechanisms
- **Contact Investigation**
  - Screening roommates
  - Screening broader healthcare contacts
  - Prospective and retrospective lab surveillance
  - Assessment of infection control practices

https://www.cdc.gov/hai/containment/guidelines.html

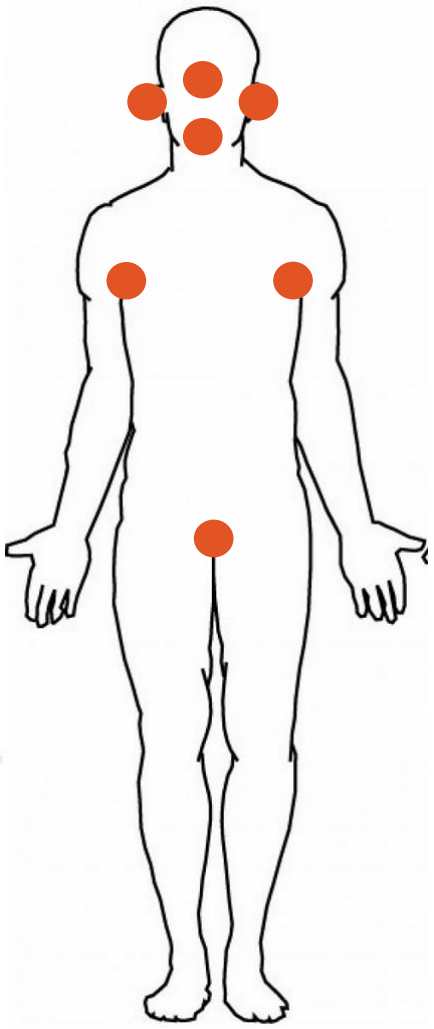
Screening Recommendations

- **Close contacts of *C. auris* patients**
- **Patients with overnight stay in a healthcare facility outside the U.S. in past 12 months**
- **Patients in high-acuity long-term care facilities** (e.g., care for ventilated patients), especially those with CP-CRE or other MDROs



Candida auris Colonization Testing

- **Must be approved by SHARP unit**
  - We can assist with obtaining specimen collection kits, contact investigation, and follow-up
- **Testing done through ARLN**
- **Axilla/groin swab most sensitive sites to detect colonization**



Infection Prevention for *Candida auris*

- **Place patients in a single-patient room, using Standard and Contact Precautions**
- **Emphasize adherence to hand hygiene**
- **Clean and disinfect patient care environment and reusable equipment**
  - Daily and terminal cleaning with EPA List K products active against *C. difficile*
- **Inter-facility communication at transfer to another healthcare facility**
- **Conduct surveillance to detect new cases and ongoing transmission**

How Healthcare Facilities Can Prepare for *C. auris*

- **Work with your laboratory to ensure your yeast identification method can identify *C. auris***
  - If it cannot, know when to suspect *C. auris* and send suspected isolates to the Bureau of Laboratories for testing through ARLN
- **Establish a surveillance protocol with your lab**
  - Prompt notification and reporting of **confirmed or suspect *C. auris*** isolates to infection prevention and public health
- **Know which patients in your facility are at higher risk for *C. auris***
  - Request colonization screening for high-risk patients through ARLN
- **Develop a facility response plan**
  - Prompt implementation of infection prevention and control measures

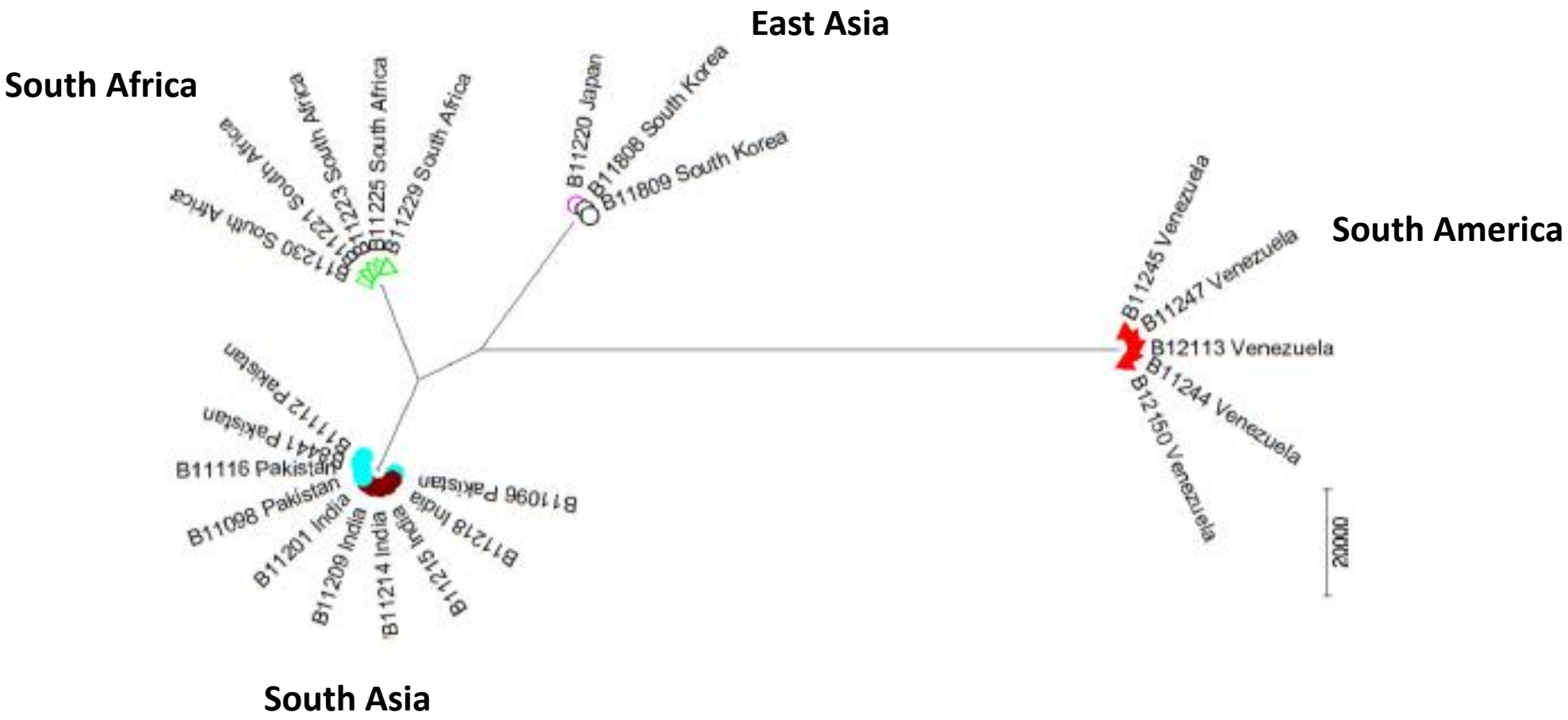
How Local Health Departments Can Respond

- **Work with laboratories, healthcare facilities and providers in your jurisdiction**
  - Prompt notification and reporting of **confirmed or suspect *C. auris*** cases
- **Facilitate submission of confirmed or suspect isolates to the MDHHS Bureau of Labs**
- **Enter case into MDSS and collect needed laboratory and clinical information**
- **Support implementation of Novel MDRO Containment Strategies**
  - Reduce transmission of *C. auris* in healthcare facilities
- **SHARP Unit can guide you through this process…**

Thank You

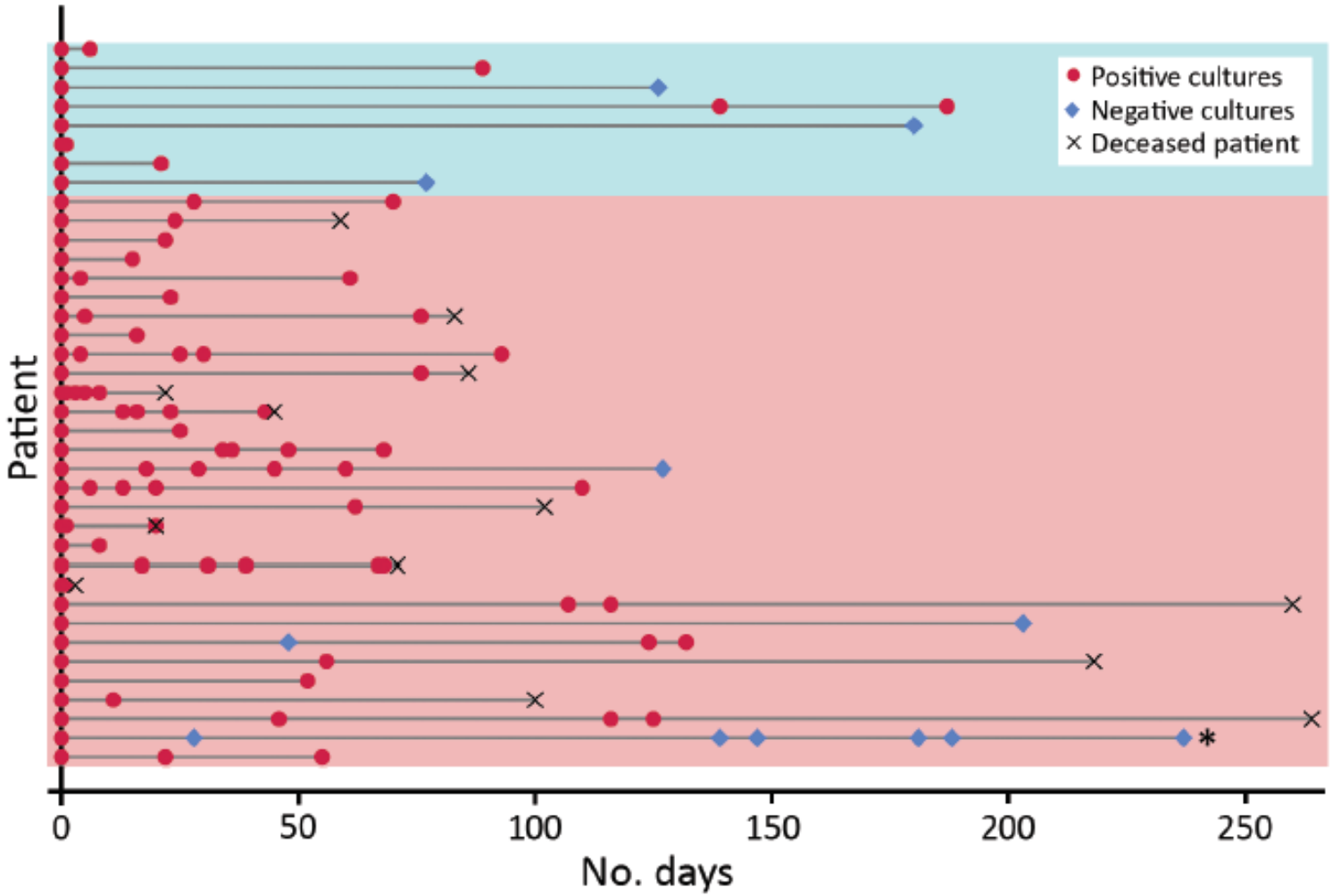
Surveillance for Healthcare Associated and Resistant Pathogens (SHARP) Unit
Michigan Department of Health and Human Services (MDHHS)
(517) 335-8165

Four Distinct Clades of *Candida auris*



Lockhart et al. Clin Microbiol Newsl. 2017; 39(13): 99-103

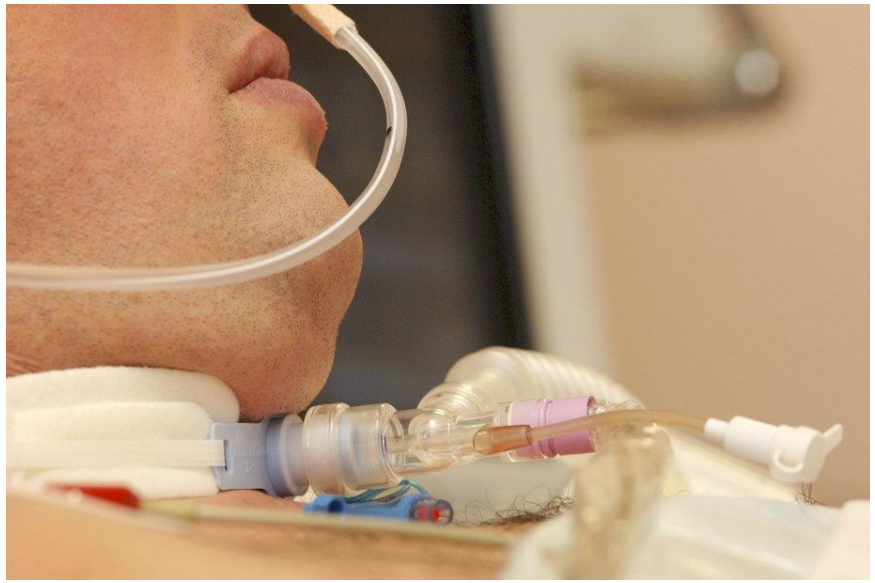
Duration of Colonization Can Be Prolonged



Adams et al. EID 2018;24(10): 1816-1824

Higher Colonization Rates in High-Acuity LTCF

- In NY, 572 patients screened in 19 facilities for *Candida auris* colonization
  - 61 (11%) were positive for *C. auris*
    - 19 (31%) admitted to acute care hospital
    - 42 (67%) resided at a long-term care facility
      - 40 (66%) were at a vSNF
- In Chicago, 1,364 patients screened in 20 facilities
  - 92 (6.7%) were positive for *C. auris*
    - Prevalence median (range):
      - vSNF - 7.7% (0-43.3%)
      - LTAC - 0% (0-14.3%)
      - Acute care - 0% (0-6.3%)
      - SNF - 0% (0-1.5%)



Adams et al. EID 2018;24(10): 1816-1824
Kerins et al. OFID 2018:5 (Suppl 1) S28